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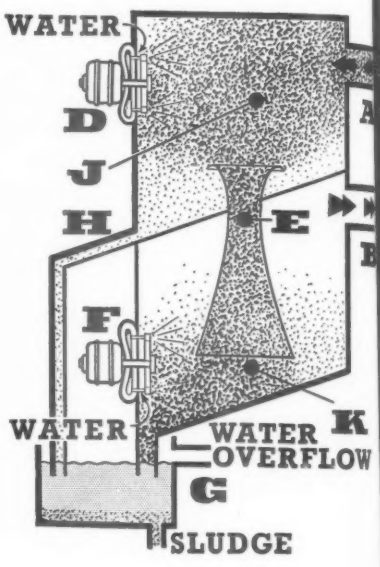

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PRINCIPAL CONTENTS

Technical : PAGE

Founding of Magnesium, by E. F. Emley, Ph.D., B.Sc., F.R.I.C., F.I.M.: In the concluding section published this week, procedures for sand-casting, gravity- and pressure-die-casting are outlined, and the application to magnesium founding of other foundry processes is dealt with. Finally the advantages of using cast-magnesium items are recorded . . . 63

Scandinavian Foundry Review : Continuing the account of the foundry industry in Sweden, Norway, and Denmark, this week's descriptions of three more Swedish foundries conclude the section of the survey devoted to that country 71

Features :

Leader: Freer Trade in Europe . . . 61
ABBF Area Notes 62
Law Cases 70
House Organs and New Catalogues (Advert section) 31

Commercial :

Company News and New Patents . . 83
Raw Material Markets 88
Current Prices of Iron, Steel and Non-ferrous Metals 90

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Freer Trade in Europe

The impact of freer trade in Europe will affect different sections of industry in different ways, of which fact the Government is well aware. The truth, according to an official account*, is that this country was faced with a situation which offered three possible fields of action. The first was to stay out and see one common tariff wall surrounding Western Europe, with free trade within; this would involve losing most of our 13½ per cent. overseas trade to this area. Such an action would see the strengthening of European manufacturing concerns, so that they would become exceedingly serious competitors in the world markets. The second approach could be to seek to join the European Economic Community and shelter behind the same common tariff walls as the other six countries. There is, however, to be borne in mind the preferential tariff, which for two decades has been in operation with the Commonwealth countries.

The third possibility is joining the ECC in a looser association—that is an industrial free trade area. By pursuing this last policy, the Report states that about 90 per cent. of imports from the Commonwealth would not be affected. Naturally, the proposed conditions give rise to many questions, about a dozen of which are answered in the Report. It would seem that labour costs do not vary so much as would be expected. What does vary, is the way in which the various peoples of Europe spend or save their money—a factor which will be of increasing importance in the future economics of Europe.

There is one phase of business which has not been expounded in the Report and that is the importance of the purchasing departments of the various Government monopolies. Sometimes, a firm works exclusively for the Coal or the Gas Board, and if this one big customer changed its source of supply, that would be the end of the concern, unless by a miracle a Continental monopoly conveniently placed a sizeable order at the right time. Dumping, it is stated, is not to be feared as underpriced goods could be shipped back to the point of origin and compete in the domestic market. We counsel that this Report should be read by all foundry owners and its statements should be pondered over, if possible, from the viewpoint of their customers. For instance, where big business is being done with the Commonwealth countries, some of which are not too keen on freer trade in Europe, these countries may well decide that the proposed policy is against their customers' best interests, whilst other clients may welcome the prospect of an enlarged market for their particular line of goods.

* "Freer Trade in Europe," published by HM Stationery Office, York House, Kingsway, London, W.C.2; price 2s. net.

Sterling Metals' Golden Jubilee

In our issue of August, 1907, under the heading of "New Companies," there was listed "Sterling Metals, Limited, capital £2,000, to carry on the business of metal founders, etc. Registered office: Bank Chambers, Newdigate Place, Nuneaton." By the time this announcement was made, a factory employing about 20 men was in being in Stoney Stanton Road, Coventry. From those small beginnings, the firm has grown into one of the largest concerns making iron, aluminium and magnesium castings on a repetition basis. Especially is it noteworthy as a company which has since 1922 pioneered the production of magnesium castings. Two years after the foundation of the company, Mr. E. Player, C.B.E., joined the staff as secretary, and to him must be given full credit for the leading position the firm now holds as producers of ultra-light-alloy castings.

To celebrate their Golden Jubilee, the company has issued a well-illustrated brochure which has recorded the great growth of the concern since its inception. It has paid tribute to those who have given long and faithful service, and by pictures, has recalled the various interesting and important components it has made for customers. A second feature of the Jubilee was the holding of a celebration dinner in Stermet Hall, Gipsy Lane, Nuneaton, at which the Most Hon. the Marquess of Exeter, chairman of the company, presided. The guests, numbering over 200, included many of the staff of Sterling Metals and its associated companies and representatives of customers, suppliers and trade associations. Speeches in connection with the toasts were made by Mr. J. Wright (Dunlop Wheel & Rim Company, Limited), Mr. Sam N. Evans (S. N. Evans, Limited, foundry-sand quarry owners), Mr. E. Player, the Chairman and Mr. H. Heath, the president of the Coventry Engineering Employers' Federation. The speeches were light and humorous, with more references to the present than to the past. This very successful function was organized by Mr. R. Player, the firm's publicity manager.

Latest Foundry Statistics

According to the *Bulletin* (Vol. 2, No. 6) of the Iron and Steel Board and the British Iron and Steel Federation, employment in steel foundries showed a reduction of 410, when the count was taken on May 4. It stood at 20,110 as against 20,520 on April 6 and 20,120 on May 5, 1956. The average weekly output of steel castings during May was provisionally recorded at the quite high figure of 6,900 tons. The corresponding (again provisional) figures for April and May, 1956, were 5,600 and 6,300 tons respectively.

Figures issued by the British Bureau of Non-ferrous Statistics show that the May production of copper-based castings was 6,654 tons. During the first five months of this year the output was 32,721 tons or 41 tons more than in the corresponding period of 1956.

According to the Ministry of Supply, the output of aluminium castings during April was 5,847 tons, of which 1,526 tons were from sand moulds; 3,081 tons as gravity-die-, and 1,240 tons as pressure-die-castings. The production of magnesium castings during this month was 200 tons.

A GIANT NEON SIGN, 367 ft. long with letters 4 ft. deep, believed to be the largest in the North of England and probably in the whole country, has been installed on the new warehouse of the Bradford engineering firm of Hepworth & Grandage, Limited.

ABBF Area Notes

Continued Technical Service to Bronze Founders

Although the three-years' Conditional Aid Programme which was organized by the Association of Bronze & Brass Founders on behalf of the British Productivity Council came to an end in September of last year, the Association still continues to give very real technical service to its members. It has just issued a survey of "Furnaces for Melting Copper Alloys" which is the last in the series of its technical reports on behalf of the British Productivity Council. At a regular quarterly meeting of members of the London area of the ABBF, held at the Clarendon Restaurant, Hammersmith, recently, Mr. E. C. Mantle, chief liaison officer of the British Non-Ferrous Metals Research Association, introduced this survey, giving details of the methods by which information had been obtained and the bases on which comparisons were made. As will be already known to members of the Association, the survey* is a complete one dealing with all types of melting furnaces for copper alloys.

Current Activities

During this meeting, a survey of current activities of the Association was given; this included details regarding the following items which aroused an interesting discussion and brought forward a number of suggestions from the members present:

"Costing a Casting." The publication of this ABBF booklet,† which is of particular interest to owners of small foundries, is expected shortly. It will be in two volumes, the first describing the method and the second containing specimen forms for carrying out a simplified costing system.

Technical Advice and Research Group. Thirty-seven members of the Association are also members of a special group of the BNFMRA which gives valuable assistance to its members. The desirability of all members of the ABBF joining this group was stressed by the chairman of the meeting and satisfaction was expressed that steps are being taken to make better known the advantages accruing from such membership.

Test-bar Casting Techniques and Properties of BS.1400 AB2. The information on this subject circulated at the request of the Association's Technical Committee was discussed.

Other topics which were considered at some length included such matters as: Clear Air Act, 1956; Safety, Health and Welfare in Non-ferrous Foundries; Census of Production; Metal Markets; Conference and National Foundry Exhibition (the desirability of holding these was discussed); Buying Coke to a Standard, and the European Free Trade Area.

On the subject of coke, a member stressed the desirability of being able to purchase foundry hard coke having a specified calorific value and standard limits for ash and sulphur contents. This matter is to be taken up by the Council of the Association.

The European Free Trade proposals are of such interest to members that it was decided to obtain the services of a full-qualified speaker to explain them and the effect they would have on the foundry trade particularly. This meeting will probably take place during the period of the Engineering and Marine Exhibition, in London next September.

* Now available to ABBF members at 10s. or to non-members at £1 per copy, from the secretaries, Heathcote and Coleman, 69, Harborne Road, Edgbaston, Birmingham, 15.

† This publication will be available to UK founders at 15s. and at £1 1s. to overseas buyers.

Founding of Magnesium

By E. F. Emley, Ph.D., B.Sc., F.R.I.C., F.I.M.

(*Continued from page 38*)

Continuing this comprehensive survey of foundry practice applied to alloys containing magnesium, this account outlines the procedures adopted in the main sections: sand casting, gravity- and pressure-die-casting, and the application to magnesium of special foundry processes. In the first of these sections, such general matters as features peculiar to certain alloys, cleaning, inspection, and surface treatment and repair of faulty castings, are also dealt with. A final section covers advantages of cast-magnesium items and lists and illustrates a number of typical examples.

SAND CASTING

Moulding Sand

For reasons already indicated, sands used for magnesium are of high permeability. The inhibitors commonly used are sulphur and boric acid, or ammonium bifluoride, the quantity required depending on the moisture content which in turn depends on the clay content. Both natural and synthetic sands are used; Table IV gives some typical compositions. Most castings are made in synthetic sands consisting of washed silica sand bonded wth bentonite. A small addition of diethylene glycol is often made to minimize drying out. Suitable natural sands have been used very successfully, but more care is then required to ensure that sufficient inhibitors are present and venting is adequate owing to the higher moisture-content of this type of sand. If sufficient inhibitors are present in the moulding sand, local reaction between magnesium and moisture in the mould may occur. This usually shows itself as white spots on the outside of the casting, but it appears that appreciable hydrogen pick-up can occur without visible signs of superficial oxidation; this may lead to increased microporosity in alloys containing aluminium and, in the zirconium alloys, to local zirconium impoverishment, coarse grain, and microporosity even in alloys such as ZREl which normally do not show any.

Cores and Chills

With careful handling, the commonly-used, synthetic moulding sand inhibited with sulphur and boric acid, makes a good core sand, and has the advantage of collapsing readily during solidification and cooling of the casting, thus offering a minimum of restraint to alloys such as Z5Z which show some tendency to hot cracking. Because most inhibitors are volatile, more may be required in core sands to allow for losses by volatilization. Oil-bound core sands have been widely used, particularly in the USA, but the cores require higher baking-temperatures, and are very hard and unsuitable for Z5Z. Urea formaldehyde resins give cores with good dry strength and collapsibility, and combined with cereal binders such core sands are suitable for use in coreblowing machines*. CO_2-Process cores are also in wide use.

Proper venting of cores is particularly important with magnesium. Chills are generally made of cast iron and dressed with French chalk/boric-acid mixture in an alcoholic base. Their use is frequently helpful in establishing desirable temperature-gradients in castings. In both the UK and USA, some founders are tending towards the replacement of sand moulds by assemblies of dry-sand cores.

Mould preparation

Thorough milling and aeration of sand are important for magnesium. Moulding and core-making follow conventional practice, various jolt, squeeze, and slinger-type machines being used, and mechanization for quantity production can be arranged where justified. Magnesium moulding-boxes are excellent and provide the rigidity required for good dimensional accuracy with lightness for easy handling. Moulds are rammed lightly, and are often "torched" or skin-dried prior to casting. Flushing with SO_2 is not infrequently employed.

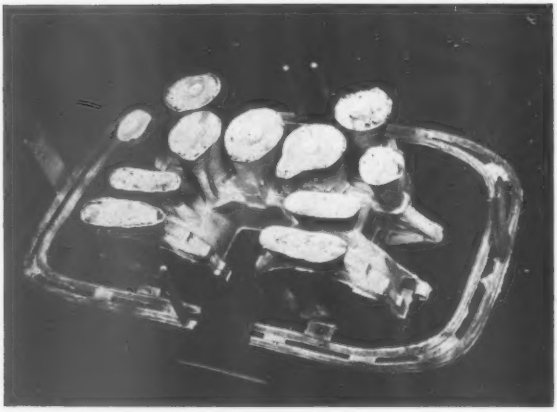
Running and feeding

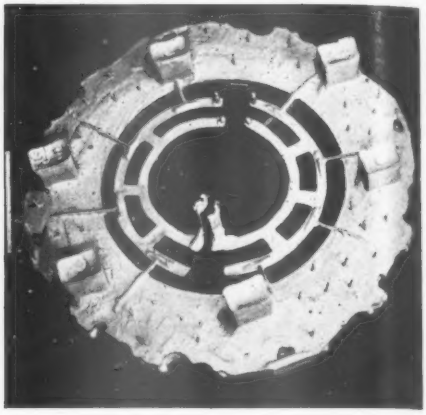
In designing running systems for magnesium, two requirements have to be borne in mind: clean metal should enter the casting from the bottom to minimize turbulence and oxidation, and hot metal should be provided later at the top of the casting to ensure adequate feeding. The low-volume, heat-capacity accentuates the latter need† and generous risers are required.

Running techniques for magnesium castings tend to fall into two groups devolving from somewhat differing philosophies, but each capable of producing excellent castings. The technique more usual in this country is to use one or more narrow rectangular sprues, which may be slightly tapered or choked to ensure they are kept full of metal, runners and gates of increasing section to reduce metal velocity, and blind runners, skim, bobs, etc., to trap scum (Figs. 4, 5 & 6). The other technique, which is frequent in the USA, employs a single, large, round sprue leading to a cavity fitted with

* For some compositions, see OEEC Report.[18]

† As a consequence of this low-volume, heat-capacity, the metal will tend to flow through the mould along certain channels which may persist because they are hotter; and this channelling effect is intensified by the nucleated fine-grain structure of the alloys, as a result of which the cooler regions adjacent to the channels are more viscous by virtue of the crystallites present. "Mass feeding" by a slurry of crystallites in liquid metal must be expected, and it is therefore particularly desirable to reinforce this feeding by establishing a reservoir of hotter liquid metal at the top of the casting.





[*Courtesy of Sterling Metals, Limited.*]

FIG. 5.—*Sand casting, double poured (using two crucibles) in alloy Z5Z. Note the use of rectangular downgates and generous feeders.*

FIG. 6.—*Sand casting, poured from one crucible in alloy ZRE1, without screens.*

(The size of the castings illustrated can be assessed from the 12-in. rules photographed alongside.)

screens from which runners of considerable size lead into the casting. This method is often associated with the practice of removing the flux cover completely prior to pouring*, with consequent desirability of fast pouring, moderate pouring temperatures, and use of screens to trap scum (Fig. 4).†

The second technique appears capable of a good deal of refinement compared with the form in which it is sometimes employed. Thus, the large sprue may be tapered to provide a choking effect, and a well placed under the sprue‡. In one particular case, a running system was changed from that in Fig. 7 (*a*) to 7 (*b*), and the casting which had previously frequently misrun filled so fast that metal spurted several inches out of the vent holes; the inference was that the scum made by the first system had blocked the screens, and this was confirmed by sectioning the screen cavity of a similarly run casting which was found to be full of skins. Had the runner been taken from the top of the enlarged sprue base in the first instance, scum formation would doubtless have been much less. The recent American work on transparent systems in which the pouring of castings can be simulated is of considerable relevance in this connection.

Thus, by use of the rectangular downgates combined with slower pouring, the first technique aims to avoid scum formation, whilst the second makes little attempt to minimize its initial producton, but relies on the screens to filter it out. There is some evidence that screens placed vertically in a horizontal runner can actually give rise to oxide skins, and Elliott§ regards the inclusion of a certain length of runner between the screens and the casting ingates as desirable, in order to remove this scum by adherence to the runner walls.

Both techniques may use ring runners, and frequent gates to distribute the hot metal uniformly and avoid running too much hot metal over the same sand surfaces. Wherever the casting shape is appropriate, an "upsprue slitgate"‖, in which the metal can rise in the vertical runner (or "upsprue"), and pass into the mould cavity by horizontal flow through the slit, is to be preferred for all magnesium alloys¶. This gives minimum scum combined with maximum soundness. In applying the upsprue-slitgate technique, the aim, as always, should be to obtain progressive directional solidification, and accordingly, the slitgates should be applied to the thickest walls of the casting, and should in general, be thicker than the casting walls**. Risers are applied to the slit itself and neighbouring thick sections. In this way, the ideal of progressive directional solidification from the thin walls to the slitgates and from the base to the risers may be approached. Fig. 8 shows the technique applied to an aircraft landing wheel. Steep longitudinal gradients are desirable in order to avoid local premature solidification from wall to wall across a section with consequent prevention of proper feeding. In general, the optimum wall-section for greatest soundness is probably about ½-in. or slightly thicker. For better control of the flow of metal through an upsprue slitgate, Elliott has recommended the use of a cylindrical screen in the upsprue.

* The metal is then protected from oxidation with a mixture of sulphur and boric acid which is more effective than sulphur alone. This procedure is not, however, recommended for the zirconium alloys.

† It should have been recorded that Fig. 4 published in last week's issue, and showing a casting made in alloy ZRE 1, was reproduced by kind permission of Rolls-Royce, Limited.

‡ For some forms of screening, see ref. [13]

§ Reference [17]. This article is one of the best on running and gating of magnesium castings.

‖ Also known as a bottom-run side-gate with well, or slot gate with vertical runner.

¶ Bottom-running techniques are unsatisfactory in principle, since they tend to overheat the bottom of the mould and so militate against the establishment of proper temperature gradients.

** Unpublished work by P. Spitaler and B. W. Peck.

Application of risers to magnesium alloys follows conventional practice. These risers should be relatively large and placed as close as possible to the sections to be fed. Tall risers of relatively-small cross-section should be avoided or premature freezing may result. Risers are preferably filled with hot metal direct from the gating system, and if an upsprue slitgate is not being used, some form of by-pass is often desirable. As a result of the generous risers and comparatively voluminous running-systems needed for magnesium, the ratios of crude to fettled weights of castings tend to be high, figures between 2.5 and 4 being most usual.

Casting Features Peculiar to Certain Alloys

Mention should perhaps be made of interesting features of certain alloys and an attempt made to relate them to the mode of solidification of the alloy.

Microporosity

The wide solidification range of the magnesium/aluminium-type alloys under foundry (non-equilibrium) conditions has already been mentioned. In the complete absence of hydrogen, it has been supposed that shrinkage takes the form of sub-

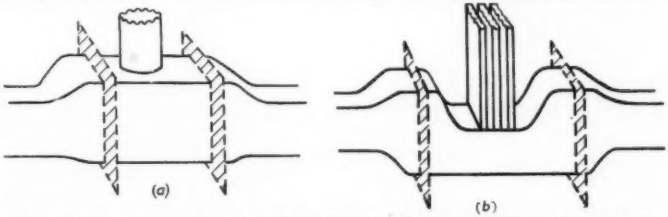


FIG. 7 (*a*) *and* (*b*).—*Two types of enlarged sprue box fitted with perforated-metal screens, the latter shown cross-hatched.*

microscopic interdendritic voids, but that any hydrogen present nucleates the formation of microporosity[18]. Under practical conditions, however, even after prolonged chlorine degassing of melts, microporosity is still encountered with imperfect feeding, and this is indistinguishable radiographically, and hardly, if at all, distinguishable microscopically, from that produced in well-fed castings from melts which contain some gas. Microporosity in these alloys takes the form of layers roughly perpendicular to the major casting axis and the temperature gradient. The phenomenon has been studied by Baker* and may well result from a "mass-feeding" effect in which, owing to the nucleated fine grain associated with these alloys, contraction is fed by a slurry of crystallites rather than by liquid metal. During the later stages of solidification, when the slurry becomes plastic, and the crystallites perhaps interlock†, transverse "tears" may develop, like crevasses in a glacier, and, unless fresh nuclei-bearing liquid can reach and enter the channels, these old tear-sites will be β-enriched and feed neighbouring regions, with development of layers exhibiting microporosity.

In the zirconium alloys, however, for reasons not yet fully understood, any microporosity takes a different form. It is arranged in ribbons or shells roughly parallel to the major casting-axis and the temperature gradient (Fig. 9 (*a*)). From a practical point of view, this has the advantage that outcropping microporosity has markedly less effect on the tensile properties of zirconium alloys than on those of alloys containing aluminium. A similar arrangement of microporosity has also been found in alloys of the type Mg-6/Zn-0.5/RE-0.5 per cent. Mn when fully grain-refined with iron, in which case the grain size is finer than can be achieved in Mg/Al-type alloys but coarser than that of the zirconium alloys. It is also of interest that a slight increase in the zinc or decrease in the zirconium content of Z5Z, each of which slightly increases the grain size and introduces very appreciable amounts of second phase, will change the distribution of microporosity from the ribbon to the layer type (Fig. 9 (*b*)). It may be that the finer crystallites of the zirconium alloys have greater mobility until near the end of solidification and insufficient coherent strength to develop incipient tears‡. They are apparently rounded and so may not interlock.§ In these circumstances, inner layers of slurry may slide over substantially solid outer layers leaving shells of relatively-coarse grain with accompanying microshrinkage.

Segregation in Alloys Containing Rare-earth Metals and Thorium

An interesting phenomenon which occurs in these alloys and was first disclosed by radiography, is that of "healed hot-tears" and "healed microporosity." Occasionally *light* markings appear on radiographs in the form of "fork lightning" or "microporosity" (which is of course normally dark), and these evidently represent incipient hot-tears and microporosity which were subsequently fed by the β-rich liquid present in quantity towards the final stages of solidification. Were it not for the radiographic density of rare-earth metals and thorium in comparison with magnesium, the phenomenon would probably not have been noticed. Skelly and Sunnucks[20], who made an extensive study of both types of segregation, concluded that they had no material effect on any mechanical

* Reference [19]: a classic article on microporosity in magnesium alloys.

† The grains of these alloys show pronounced dendritic coring.

‡ Suggested by P. Spitaler.

§ In this connection, it is perhaps significant that it is readily possible to separate the zirconium-rich nuclei in a solidifying melt either by centrifuging or by shaking into rhythmic layers with standing waves, the segregating crystallites at this stage being simply the round zirconium-rich "cores" normally present at the centre of most grains in alloys of full zirconium content. Reduction of the zirconium content of Z5Z, whereby layer porosity is produced, is, however, accompanied by the appearance of dendritic coring in the grains, in apparent accord with an interlocking hypothesis. (The result of centrifuging during solidification is to produce a solid block of metal which is extremely fine grained on the outside but with very large grains on the inside, despite soluble zirconium contents as high as 0.3 to 0.4 per cent.)

FIG. 8.—*Aircraft landing-wheel casting run with "upsprue slitgate" technique. Note the four upsprue slitgates, chilled tyre-seating area, and generous ring feeder with by-pass to feed the central parts.*

property. These segregations can, however, usually be eliminated by measures to reduce hot-tearing and improve feeding. As with Z5Z, if the zirconium content of ZRE1 is reduced, the grain structure is coarsened, the solidus probably lowered, dendritic coring appears, and some microporosity of layer type can arise.

Cleaning, Inspection and Surface Treatments, etc.

After cooling sufficiently, the castings are shaken from the moulds on a vibratory shake-out, cores are removed, risers and runners sawn off with a band saw, and the castings subjected to shotblasting or other cleaning treatment* before the first careful visual inspection. Additional fettling and mechanical cleaning operations, and frequently an acid pickle (5 per cent. HNO_3) or chromate treatment, prepare the way for a further inspection† including dimensional checks, crack detection, radiography, pressure-tightness, etc., as may be required. Before despatch, castings are usually given a final chromate-treatment by immersion, for example, in the acid chromate or the chrome/manganese baths‡.

Heat-treatments are carried out in conventional manner. For temperatures over 350 deg. C., some SO_2 (about 1 per cent.) is required in the furnace atmosphere to prevent oxidation. None of the alloys require quenching from solution treatment temperature. The zirconium alloys used in this country need only moderate temperature precipitation or stabilizing treatments to develop their properties. Adequate stress-relief[2, 28] can be obtained in castings of all alloys, and if necessary, castings may be "set" in jigs to exact dimensions, without damage to their mechanical properties. Although magnesium castings are successfully employed in the unprotected state, some form of protective treatment is desirable for many applications. Nothing sticks to magnesium better with an epoxy resin of the type Araldite 985E, and "surface sealing"§ with this resin provides the best base for all subsequent paint treatments. A full protective scheme for a casting to be used in unfavourable conditions, *e.g.* parts of an aircraft which are not open to inspection but where condensation of water is likely, might be as follows: fluoride anodize, chromate treatment, surface seal with epoxy resin, conventional paint scheme.

Repair of Faulty Castings

With the exception of Z5Z, castings in all the alloys appearing in Table II can be successfully welded by the inert gas-shielded tungsten arc (argon arc) process.[29, 30] Impregnation of porous castings of the Mg/Al-type with linseed oil or various resins is still sometimes carried out, though use of a completely pressure-tight alloy such as ZRE1 seems much to be preferred.

GRAVITY-DIE-CASTING

Much that has been said before concerning the casting behaviour of the various alloys, and about cleaning, inspection, and surface treatment is applicable in principle to gravity-die-castings, and only points peculiar to the latter subject need be mentioned in this section. Higher properties are naturally obtainable in chill castings than in sand castings, but the choice of this method for a given job must presuppose that the quantities required and the shape and size are appropriate to it. Much care is desirable in designing the die, and in particular, to ensure that sharp corners, abrupt section changes, etc., are avoided to minimize risk of cracking.

Melting is usually carried out in crucible-type, lip-axis tilting furnaces of moderate size, though bale-out furnaces are also used. Castings are poured from hand ladles filled from the furnaces. Ladles are either simple bowl-shaped (no dressing being then required) or else partially covered and with a short pouring-spout, in which case, cleaning is effected by dipping into a fluid flux bath and draining thoroughly. Ladles for bale-out furnaces may have a skimmer plate attached to the back for parting the flux cover. With bale-out furnaces, melting may be carried out in the normal way, or by the "open-pot" method[4] in conjunction with a fluid flux-cover which may be "self-sealing"; or melting may be carried out conventionally and the metal then transferred to a separate crucible in which it is held under a sulphur dome as is usual in pressure-die-casting. Prolonged holding of melts at low temperatures promotes grain coarsening, so that a supplementary carbon-inoculation, or puddling treatment may become necessary during the course of casting.

* Shotblasting is useful in exposing sub-surface defects such as dross and blowholes. Unfortunately, it has a bad effect on corrosion resistance, and has been prohibited for this reason from being applied to high-purity-alloy castings unless the surface is subsequently removed by machining or acid pickling to a minimum depth of 0.04 in. Such castings can, however, be safely cleaned by anodizing in NH_4HF_2 solution,[21] and this process may also be applied to remove the iron-contaminated surface from castings which have been shotblasted, thereby restoring the inherent corrosion resistance of the alloys. This fluoride anodizing process is covered by British Patent No. 721,445

† Inspection and control of castings is dealt with more fully in the paper by Emley and Fisher[2] already cited, which discusses the origin and prevention of various defects, and contains a number of references relating to casting quality.

‡ For details, see DTD911B.

§ In applying surface sealing,[21] the casting is preheated to the full stoving temperature (220 deg. C.) so as to drive off any moisture remaining in surface pores, etc. The resin goes through a labile stage before polymerizing and so is able to enter and seal surface cavities.

The alloys usually employed are AZ91 and C alloy, and small additions of beryllium (*e.g.* 0.001 per cent.)* or calcium (0.02 to 0.1 per cent.) are frequently made to minimize oxidation. Pouring temperatures are naturally as low as possible. Mould temperatures of 300 to 350 deg. C. are usual. Die washes, *e.g.* of talc and boric acid, prevent sticking of the casting in the die, and also temper somewhat the chilling effect of the latter: in fact, the thickness of the die coating can be varied to assist in setting up the desired temperature gradients†.

PRESSURE-DIE-CASTING

Both hot- and cold-chamber machines are in use for production of magnesium pressure-die-castings. Output is expanding, for in this way, thin-walled castings of considerable size are possible, so that the advantage possessed by magnesium of high stiffness to weight ratio in addition to high strength to weight ratio, can be fully realized. Faster casting speeds can be realized with magnesium than with aluminium or zinc[32], and die "lives" are longer. Magnesium pressure-die-castings have been made successfully in high-purity alloys (DTD684) by the cold-chamber process to meet aircraft Class 1 inspection requirements. In general, the quality of hot-chamber-process castings is perhaps not so high, but examples of remarkable size and complexity have been successfully produced to commercial standards, particularly by Mahle in Germany.

Melting is frequently carried out with fluxes in conventional manner and the metal then runs into a holding crucible where it may be held at temperatures around 620 deg. C. under a steel dome into which SO_2 is injected[16]. For the cold-chamber process, metal is withdrawn from the crucible through a door in the dome by ladle. In some cases, best results are achieved by having the metal itself in the pasty state in the holding crucible. In hot-chamber machines, melting may be carried out without flux in a confined space using sulphur or SO_2 to minimize oxidation[16, 31]. Only ingot of clean surface appearance is melted in this way, other scrap being melted separately under flux in the normal manner, and cast into ingot before feeding to the hot-chamber machine. AZ91 and Meltron C alloys are used, sometimes with a small beryllium addition to reduce oxidation. The heavy chill associated with the process masks the usual grain-coarsened effect of the beryllium.

Miscellaneous Casting Methods

Magnesium castings can be produced satisfactorily by the shell-moulding process using 1 per cent. ammonium borofluoride as inhibitor[23]. Reference has already been made to the value of pressure-die-casting in producing thin-walled magnesium castings. Thin-walled sand castings have been made by the so-called "Osbrink process"‡ along conventional sand-casting lines, but with the exercise of exceptional skill and precision. These are typified by the "fishing pole"§ and folding-wing-section¶ castings. Other processes with other media are being explored. Also of interest from the points of view of thinner castings, better surfaces, and closer

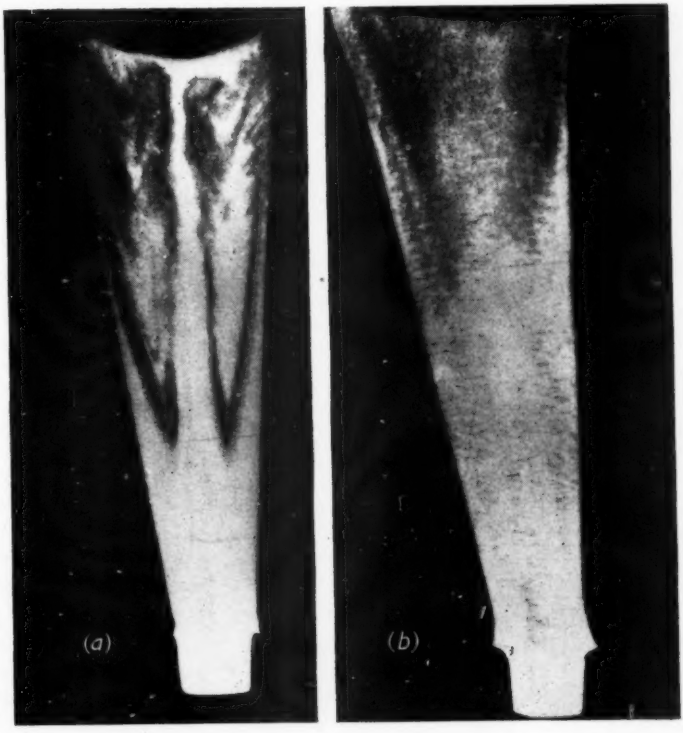


FIG. 9.—*Types of microporosity in magnesium alloys. (a) ribbon-type characteristic of the zirconium alloys (alloy Z5Z) and (b) layer-type characteristic of aluminium-containing alloys, but here due to a low zirconium content (alloy Z5Z).*

* The beryllium addition must be strictly limited because of its grain coarsening effect.

† G. B. Partridge.[33] This monograph gives much useful informationover the whole field of magnesium castings production.

‡ Osbrink Manufacturing Company, Los Angeles.

§ Leading edge of aileron for a fighter aircraft: approximately 7-ft. 6 by 5 by 6-in. with slight taper and walls $\frac{1}{16}$ to $\frac{5}{16}$-in. Weight 10 lb.

¶ For Chance Vought Aircraft's guided missile "Regulus I." Platform area 28-sq. ft. Skin section 0.18 to 0.25-in. Weight 163 lb.

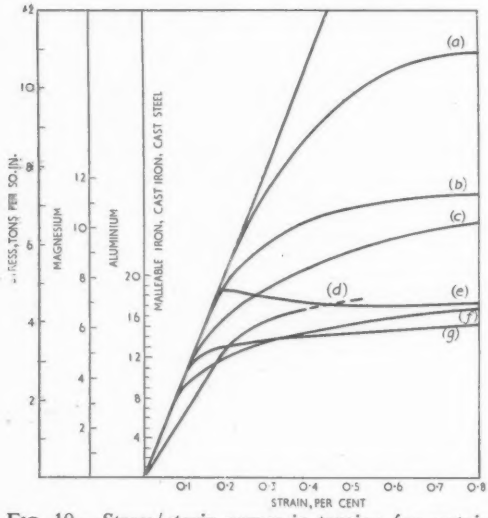
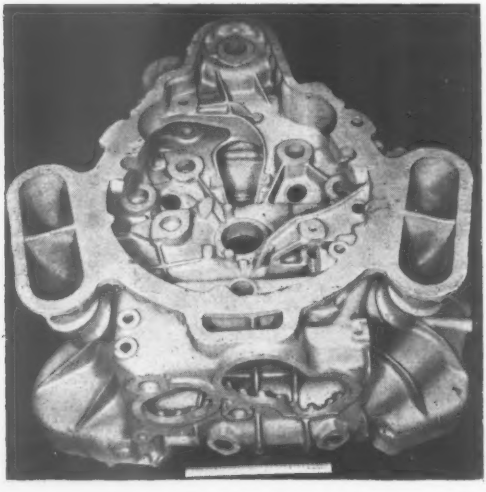


FIG. 10.—*Stress/strain curves in tension for certain casting alloys, plotted with the stress scales in inverse ratio to the densities (a) magnesium/zirconium alloy Z5Z, (DTD. 721 A); (b) aluminium alloy L 53, STA 7—AC 10, BS 1490—LM 10; (c) magnesium alloy A. 8, L. 121; (d) cast iron, BS 1452, Grade 17; (e) cast steel, BS. 592, Grade C; (f) aluminium alloy, DTD. 424A, STA. 7—AC 4, BS. 1490—LM 4; and (g) malleable iron, BS. 310. For magnesium alloys, Young's modulus is* 6.5×10^6 *lb. per sq. in.; for aluminium alloys* 10×10^6; *for malleable and cast steels* 29 × 10^6, *and for cast iron* 16×10^6.

FIG. 11.—*Sand casting in ZRE 1 alloy, illustrating the size and complexity possible with magnesium (weight 350 lb.).*

[Courtesy of Sterling Metals, Limited.



tolerances is plaster casting[24]. Chem-milling can usefully be applied to conventional sand castings to reduce weight for aircraft and other applications. Various investment-casting processes are being currently explored both in this country and in the USA.

ADVANTAGES AND TYPICAL APPLICATIONS

In conclusion, it may be useful to summarize some of the principal advantages which magnesium-alloy castings can offer and to indicate typical applications:—

Advantages: (*a*) Outstanding strength to weight ratio (Fig. 10); (*b*) low machining costs[25]; (*c*) ease of founding, exemplified by the complex casting shown in Figs. 11 and 12; (*d*) weldability of both high-strength and creep-resistant alloys; (*e*) complete pressure-tightness; (*f*) creep resistance to temperatures approaching 350 deg. C.; (*g*) high stiffness to weight ratio possible in thin-walled castings, and (*h*) low notch sensitivity in fatigue and good ratio of fatigue endurance to UTS. In addition to its technical advantages, magnesium metal can be produced in virtually inexhaustible amounts from materials readily available in this country.

TABLE IV.—*Typical Magnesium Moulding Sands.*

	British.*	American.†	
	Natural.	Synthetic.	semi-synthetic.
Clay	8	—	1
Bentonite	—	3	3
Sulphur	6	4½	1.5
Boric acid	0.3	0.3	1.5
Potassium fluoborate ..	—	—	0.5
Diethylene glycol	—	0.25	1.5
Moisture, per cent. ..	5—6	2½—3½	3
Compressive strength (green), p.s.i.	10—13	11—15	10—12
Permeability (green) ..	30—40	80—100	80—100

* G. B. Partridge (1948). †OEEC Report (1956).

Applications: The outstanding commercial application of magnesium castings at present is probably in the Volkswagen car[26] where 36-lb. magnesium castings (gravity-die) save 110-lb. weight, promoting the desired weight-distribution, and for which the annual tonnage reaches five figures. Other applications include crank cases, transmission cases*, gear cases, sumps, clutch housings, chassis, wheels, truck body components, etc., for land transport, components for portable tools, lawn mowers, vacuum cleaners, ventilating fans, electronic equipment, covers, hospital X-ray equipment, radar equipment, and moving parts of textile machinery; whilst pressure-die-castings find uses in fan casings, oil-pump housings, camera bodies, electric motors, typewriters, printing equipment, and motor-scooter body frames.

Where machinery is required to move faster, in many instances the use of magnesium is not only the answer but also the most economic one. The high strength and stiffness to weight ratio of the structural alloys, the attractive properties of the

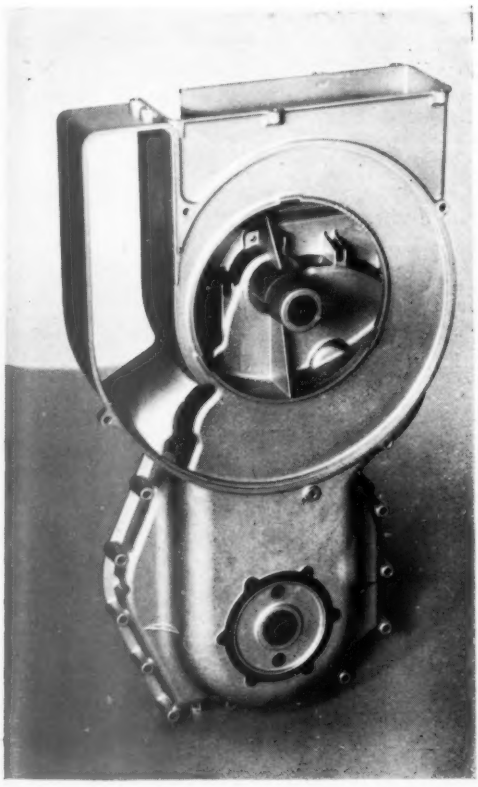
* For production of the Ferguson tractor transmission-case, see Sully.[27]

creep-resistant alloys up to 350 deg. C., and the excellent castability of both types have resulted in their widespread adoption by the aircraft industry for primary components for airframes and engines, often of considerable complexity and thin section. In addition, the alloys are used for secondary, but no less important, applications for civil and military aircraft as well as for guided missiles.

Typical of structural applications are landing wheels (Z5Z, A8), a use which for many years has been almost exclusive, undercarriage legs (Z5Z), cockpit canopies (RZ5), gear-box castings (Z5Z, RZ5), main frames and wings for guided missiles (Z5Z, RZ5). The Comet 1 and Britannia contain respectively over 1,000 and over 300 magnesium-alloy castings. Uses in the aircraft-engine field, both gas-turbine and piston, are typified by compressor and diffuser cases (ZRE1, ZT1), air intakes (ZRE1, RZ5, A8), main support plates (ZT1), crank cases and covers (A8). The Rolls-Royce "Dart" engine, used so successfully in the "Viscount," contains 82 magnesium-alloy castings, equal to 19.4 per cent. of the net dry-weight of the engine. Corresponding figures for the new and interesting Napier "Gazelle" helicopter free-turbine engine are 78 castings totalling 23 per cent. of the net dry-weight. Security considerations prevent discussion of applications in the guided-weapons field, but magnesium alloys are used for many structural purposes, including those where kinetic heating is a problem.

FIG. 12.—*Pressure-die-casting made in a hot-chamber machine.*

[Courtesy of Mahle-Werk GmbH.



Acknowledgments

The Author's thanks are due to the directors of Magnesium Elektron, Limited, for permission to publish this Paper.

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DISCUSSION

The following is a résumé of the salient features emerging during the discussion when a paper on the above subject was given by Dr. E. F. Emley to the London local section of the Institute of Metals at which the London foundrymen were guests. The Chair was taken by Mr. R. G. Harper who deputized for Dr. E. Rhodes. Major C. J. P. Ball, president of the Institute of Metals, honoured the section by his presence on this occasion. It transpired that:

If walls can be made thin enough, magnesium structures can be produced with much greater strength for a given weight than in other metals. Although such structures can be made from welded sheet or extrusions, if sufficient quantities are involved, pressure-die-casting can prove far cheaper. One speaker had recently visited Germany in connection with the production of a large component, roughly 2-ft. by 4-ft. by 9-in. This had been designed as a pressure-die-casting with wall thicknesses of about 3 in., but for successful production as a hot-chamber die-casting, he had been surprised to learn the walls should be only 2 to 4-mm. thick. This was further evidence of the value of pressure-die-casting for magnesium, and there was an evident need for greater experience with the process in this country. The hot-chamber process has the advantage of greater speed, but the higher pressure possible with cold-chamber processes may make their use preferable for castings with wide variations in wall thickness. The mechanism of grain refinement of alloys by superheating was still not clearly established, but most

or all of the experimental facts appeared consistent with the view that the refinement was attributable to formation of Al_4C_3 nuclei.

Amount of Zirconium

Because of the slow precipitation of dissolved zirconium from magnesium-alloy melts by various causes, *e.g.* pick-up of iron from the crucible or of aluminium from traces of its compounds present as impurities in the fluxes used, zirconium-alloy melts are never in static equilibrium, and in order to hold the dissolved zirconium-content of a melt at the desired saturation level, it is essential to use an excess of zirconium-alloying agent. In this way, fresh zirconium can dissolve in the melt as rapidly as precipitation through the action of impurities can occur. Amongst the various precipitating impurities is hydrogen, and this can arise, in addition to other ways, through chemical reduction by magnesium of traces of moisture in the fluxes and alloying salts used, all of which are to some extent deliquescent.

Law Cases

Inquest on Crane Victim

At the inquest at Keighley, on the 56-year-old labourer, Richard Hughes, who—as briefly announced in last week's JOURNAL—was killed when an overhead crane fell on him at the works of the Rustless Iron Company, Limited, Keighley, on June 26, the jury returned a verdict of "Misadventure," adding a rider that further precautions should be taken on all cranes of this nature to ensure that such accidents did not happen again. A police officer gave evidence that Hughes had been taken from underneath the crane which had fallen on him in the barffing department. He said the overhead rails on which the crane travelled, ran the whole length of the department, and there were two broken bolts three yards away from the fallen crane. Fred Reynolds, a shotblaster, mentioned that when the crane passed over a certain joint in the rails it made an unusual "clicking noise," and it had done so for a long time. He said he heard the crane stop and start again and also heard it go over the section of the rails where it made the "clicking" noise, then, on looking up, he saw the crane falling. As it was falling he noticed that it was off the rails at one side; he had never known it come off the rails before. He said that it was not possible to work the crane without standing underneath it. As far as he knew the rails were cleaned and oiled, although the last time this was done, to his knowledge, was 18 months or two years ago.

Albert Connelly, chief engineer of the Trico works, said the crane had a maximum speed of 150 ft. per min.—about two miles per hour. There had been no trouble with the travel of the crane and the rails were cleaned once a year. He had inspected them a month or two before the accident and they had then appeared to him to be satisfactory. He said there were two different kinds of rail in the track, but he knew nothing of a different sound while the crane passed over a certain portion of the track, although he was aware of the "clicking" noise. There was a defect in the alignment at the joint of the rails, but this caused no difficulty in moving the crane, he added that it was not usual to lubricate the rails. Having examined the crane since the accident, the witness was of the opinion that the mishap occurred because the crane had been reversed suddenly. It had jumped the rails and had travelled about 20 ft. before it fell to the floor. He mentioned that the crane was last examined by an expert in February and it was examined twice a year. Dr. Edgar Lightfoot, a lecturer in civil engineering at Leeds University, considered the crane unsafe. The crane, he said, was askew, and although a certain amount of wandering was usual with this type of crane, the extreme amount possible seemed to have occurred in this case. Mr. Sydney Newton, an insurance engineer, maintained that the crane was safe when he inspected it in February. He said it was not his duty to inspect the rails, but suggested that pieces of slag-like material on the rails might have caused the wheels to lift.

The Craven Coroner (Mr. Stephen B. Brown) paid tribute to the help received from the staff of Leeds University and he expressed his appreciation to the staff of the university, who in this and in many other cases had given very great assistance in the consideration of problems of this kind. Commenting on the evidence of Mr. Newton, he said he found it difficult to believe that substantial pieces of material could find their way up on to the rails. They had the evidence of Dr. Lightfoot, who he regarded as an expert on this matter, that the measures adopted in connection with the construction or installation of this crane were such as to have, to some extent, contributed to Hughes' death.

Claims for Personal Injuries

At Leeds Assizes, Mr. Justice Hallett gave judgment for the defendants, Fairbairn Lawson Combe Barbour, Limited, engineers, Wellington Foundry, Leeds, against James Waterhouse, who claimed damages for personal injuries sustained when his feet were trapped by a falling beam on May 26, 1954. As a result of the accident Waterhouse had had difficulty in walking for the past two years but was now completely recovered. It was alleged that the system of work at the foundry was not safe. The Judge expressed himself not satisfied that the accident happened in the way described by Waterhouse, and held that there was no negligence on the part of the defendants.

In another case, Mr. Justice Hallett gave judgment by consent for £700 and costs to J. S. Smalley, foundryman, for personal injuries sustained when working for the Low Moor Alloy Steel Works, Limited, of Bradford.

British Piston Ring Site Appeal

In the matter of the appeal by the British Piston Ring Company, Limited, Coventry, against the refusal of the County Planning Authority to grant permission for the construction of a new foundry at Gipsy Lane, Nuneaton, the company has been advised by the Minister of Housing and Local Government that the appeal has been dismissed because it is considered that "the foundry would constitute an unwarranted encroachment into the green belt and would be injurious to the amenities of the area." (The inquiry was reported in this JOURNAL, April 11, page 454.)

A SHELVING SYSTEM, based on removable cantilever-brackets, supported in slots on a vertical upright, has been introduced by Savage and Parsons, Limited, Watford, Herts. The upright may be screwed to the wall or can be a double-sided member, fixed to the floor and ceiling. Flexibility of layout is possible as the position of the shelves can be altered by moving the brackets up or down.

Scandinavian Foundry Review

Special Survey conducted by the Editor

(*continued from page* 51)

Husqvarna

Husqvarna Vapenfabriks Aktiebolag (the Husqvarna small-arms factory) is the name of a group of factories situated in the Jonkoping area which lies at the southern tip of the 80-miles long Lake Vatteren. At Jonkoping there is a foundry school which the writer understands is the only one in Sweden.

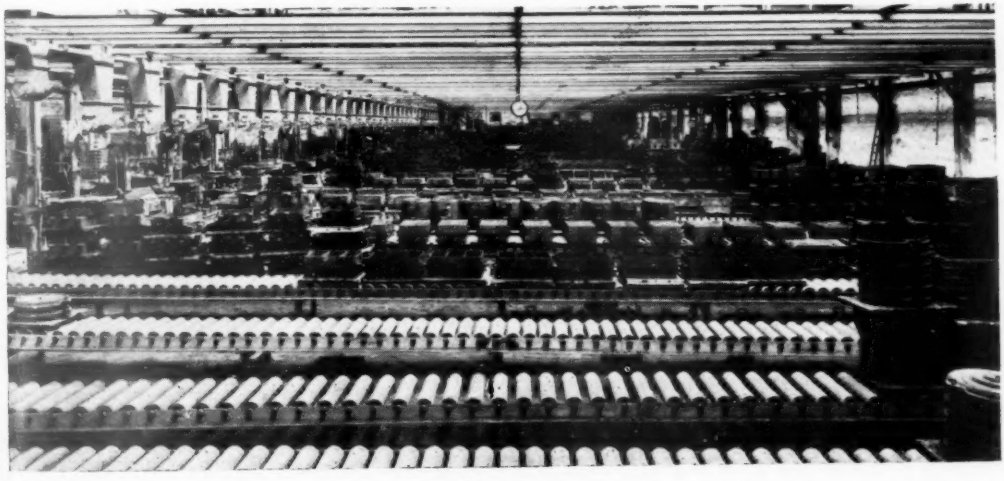
An idea of the size of this enterprise will be gained from the fact that each year it produces some 75,000 electric irons; 60,000 motor cycles; 25,000 sporting rifles (mainly for export); 300,000 pots and pans (practically all vitreous enamelled); 30,000 electric cookers; 200,000 to 300,000 mincing machines; 16,000 double gas ring boiling plates; 60,000 lawn mowers; 110,000 sewing machines (sold in the UK under the trade name of "Viking"), and 15,000 electric washing machines.

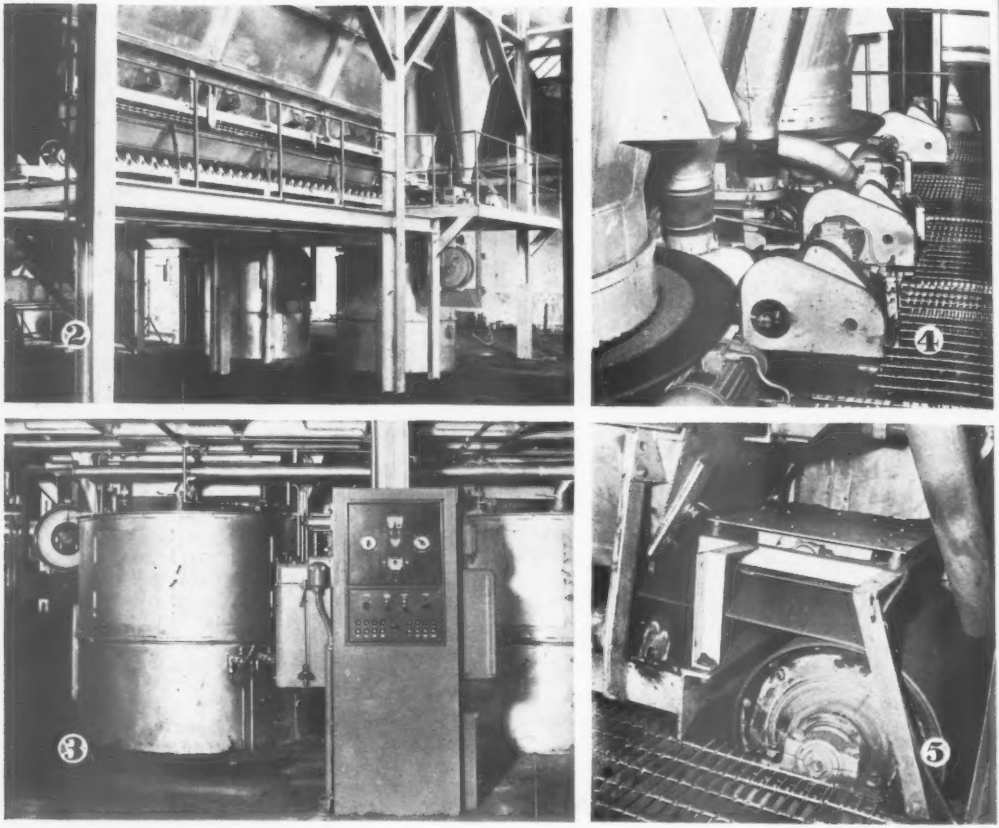
History of the Company

The Husqvarna concern consists of three separate plants: the main factory at Husqvarna, one at Norrahammar (a few miles south of Jonkoping), and a third plant at Aminne. The main company was founded in 1689 as a gunsmiths, extending later to embrace muskets, bayonets and pikes, on a considerable scale. In 1918, the famous old-established (1618) firm of Norrahammars Bruk was acquired, and so merged two of Sweden's largest foundries. With the Aminne concern, these foundries turn out about 25,000 tons of grey-iron castings per annum.

The Husqvarna, and associated foundries, each occupy an area of 1,076,200 sq. ft. Whilst the whole factory employs some 3,500 people, the personnel of the foundry is about 250, of whom about 10 per cent. can be classed as skilled operatives. In addition to producing grey-iron castings, a quantity of pressure-die, light-alloy and zinc castings are produced. In the foundry, there are two lines of moulding machines, one of which is shown in the general view in Fig. 1. The lines of machines are comprised of 44 and 30 moulding machines respectively. It is of interest to note that the hoppers serving these machines are all provided with a wire-mesh window which is banged when the sand is inclined to stick. The sand used is of the "river" type, bonded with bentonite, and coal-dust additions are also made. A sand conveyor carries the spillings made during moulding and these fall through a grating back to the sand-preparing plant. A scraper conveyor is used to facilitate the feeding of the moulding-machine hoppers. The moulding machines are served by an extensive system of parallel gravity roller conveyors terminating at shake-outs. The metal reaches the pouring stations in monorail-suspended shanks, handled by one man. These are home-made and appear to be efficient. Very large use is made

FIG. 1.—*General view of the main moulding shop at the Husqvarna works, on the left can be seen the line of* 44 *moulding machines, with their overhead sand hoppers.*





FIGS. 2 TO 5.—*Four views of the automatic sand-plant at the Husqvarna concern's Norrahammar works.*

of Sterling moulding boxes, which are returned to the moulders on the second leg of a pair of roller pathways. A variety of moulding machines are used, all of continental make. The knocked-out castings are loaded into stillages for transfer by fork-lift trucks to the fettling department. The efficiency of the whole plant can be judged by the statement that between 50 and 55 man-hours are absorbed for each ton of good castings made. In the Husqvarna plant, 300 moulds per 8-hour day, using facing sand and 20- by 18-in. boxes are made by each man. Last year, the total scrap from the foundry, machine and enamel shops was of the order of 5 per cent. As the pots and pans manufactured are but $\frac{1}{16}$-in. thick and enamelled in pleasing colours, it is thereby able to meet the competition of aluminium ware. The major sources of loss are short runs and breakages in handling. The core sand used in this works is bonded with toll oil, which is a by-product of the paper-making industry. Fordath mixers are employed throughout this department.

Melting

Liquid metal is supplied by a hot-blast cupola plant known in Great Britain as the Cupodel. The very hot metal is tapped into a drum-type ladle which feeds the monorail-suspended shanks.

Finishing Department

In the finishing department, the main item of plant is a continuous stove supplied by Ferro Enamels, Limited, of Wombourne. It is controlled at 780 deg. C. A one-coat enamel which is prepared in the factory is used on parts for wood-burning stoves, but for the rest, the frits are supplied by Stewart and Gray, Limited and Ferro Enamels, Limited.

Patternmaking

Good patternmaking facilities are available for producing wood and metal patterns; both Wadkin and German-made machines are used. The finish of the metal patternplates is of a very high standard.

Transport

The foundry is served by sidings from the railway system and throughout the foundry and fettling shops, stillages and both hand- and mechanically-operated fork-lift trucks are employed.

Norrahammar Works

The Norrahammar foundry, employing some 220 men, makes a heavier type of casting than is produced at Husqvarna. There are 18 moulding machines devoted to the making of castings of central-heating boiler sections and 16 for general work. The former seem to be of a much heavier and larger type than is usual in this country. For manufacture of these weighty components, both American and German moulding machines are in use. Good mechanical-handling devices are used for transferring the moulds to lengths of roller conveyors.

Sand Preparation

The sand is prepared in a wholly-automatic unit and by this is meant that a button is pressed for starting in the morning and pressed again for stopping at the end of the day's work. The equipment for this plant has been designed by the company's own staff, utilizing such standard equipment as Simpson mixers. It is a double unit, each half producing some 20 tons of sand per hour; moisture content of the sand is controlled at 4½ per cent., plus or minus 0.30 per cent. The management learned that a German firm were controlling the moisture content in a paper mill by a system which seemed applicable to sand preparation. This involved the installation of a generator running at the high frequency of 2,000,000 periodicity, a condensation plate, an integral regulator and magnetically-operated valves for adding water. A general view of the sand plant is shown in Fig. 2; the control panel in Fig. 3. Fig. 4 shows the regulating system for controlling the supply of new sand, coal-dust and bentonite to the mill (used sand entering at the far side). Mr. Soderland, the general manager of the foundry group, has furnished a more detailed description of how the electrical system of controlling the water content operates, and this is printed as an appendix. The majority of cores utilized in the shop are made on Champion coreblowers, shown in Fig. 6.

Melting

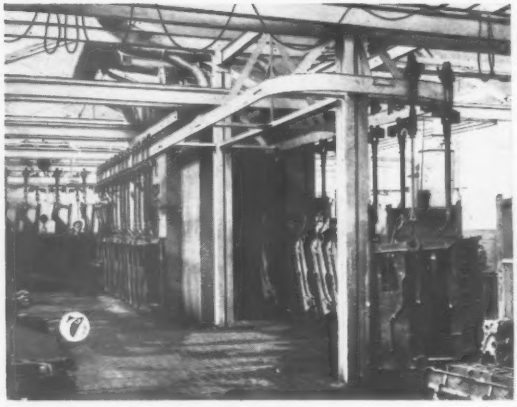
Hot-blast cupolas are also used at Norrahammar for supplying the liquid metal, but here they are of the Schacht type. Bottom-discharging skips, resting on the half of a turntable nearer to the furnace, are electrically hoisted to the charging door which opens automatically. The skip is racked out into the furnace, the load discharged, the empty bucket is then racked in, and the charging door automatically closed. The empty skip descends to the turntable which is rotated and a filled skip is then in position for hoisting. This, however, is delayed until a photo-electric cell indicates that the position of the charge, in the cupola, is such that a fresh charge is required.

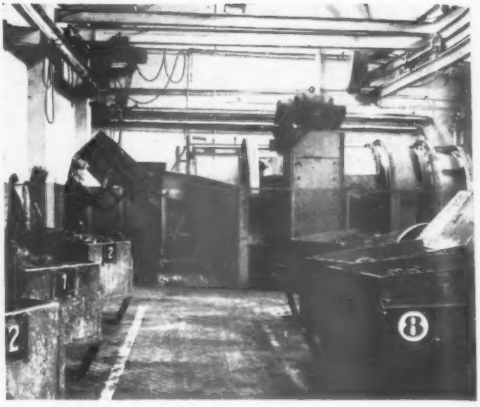
In addition to the cupola, there are three high-frequency furnaces, two having a capacity of six tons and the smaller one with a 10-cwt. capacity. The larger furnaces work continuously; during the night they are used for special pig-iron produced from steel scrap and ferro-silicon, most of which is for their own consumption. Recently, however, a considerable quantity has been sold to Japan. The small furnace is used for making special irons such as s-g iron. The production of these units is of the order of 5,000 to 6,000 tons a year.

Cleaning and Fettling

Apart from the items of a conventional character in the cleaning and fettling sections, there are two which are noteworthy. One is continuous shot-blast plant for cleaning boiler sections (see Fig. 7) and the second is the outsize tumbling barrel shown in Fig. 8. The skips shown on the left carry a load of from 20 to 25 cwt. of castings, the heaviest of which will be of the order of 40-lb. As abrasive, small white-iron stars are used, the water circulating in the barrel is maintained at 60 deg. C. and an inhibitor is added to the water. After about 10 to 15 min. the direction of rotation is changed which allows the stars to drop through perforations,

FIG. 6.—*Four Champion coreblowers in the coreshop at the Norrahammar works of the Husqvarna firm in Sweden.*





FIGS. 7 AND 8.—*Two views of the cleaning and fettling departments at the Norrahammar works. Fig.* 7: *Continuous shotblast plant for cleaning boiler-section castings; castings are conveyed from the knock-out to this plant by means of an overhead-suspension rail. Fig.* 8: *Large tumbler-mill in operation, skips containing about* 20 *to* 25 *cwts. of small castings (max. weight about* 40 *lb.) are raised and tilted, to discharge the contents, by means of an electric hoist. (Husqvarna Vapenfabriks).*

for reclamation, whilst the cleaned castings are discharged.

Aminne Foundry

The Aminne foundry, which the writer did not visit, is devoted to the manufacture of hand-moulded castings for weighing machines, machine-tool parts, printing presses, etc.; annual output is of the order of 15,000 tons.

Central-foundry Research and Development-department

The development department of the Central foundry is under the direction of Mr. Bertil Thyberg, the chief metallurgist. The department is housed in a five-floor (plus basement) building and is staffed by twenty technologists with twenty assistants. There are nine sections, and of those not usually encountered in foundry research departments are ones devoted to powder metallurgy, surface finishing and vitreous enamelling. As the products of the works are exported to the four corners of the world, including the tropics, research is being undertaken on the behaviour of the materials and their packaging in a steam room at 100 deg. F., with an atmosphere carrying 90 per cent. humidity. There is an experimental foundry in which metal is supplied by a 1 cwt. high frequency furnace. The instrumentation of the laboratories is of a high order and no expense has been spared to provide the best makes of mechanical-testing equipment, microscopes, and physical apparatus.

Conclusions

The group of foundries is unquestionably very well managed, splendidly equipped and is giving excellent service to the machine shops servicing a wide variety of finished products. Until recently, a malleable foundry was operated making quantities of castings for the automobile industry but the management pursued the policy that economical production demanded, in a country the size of Sweden, a larger concentration than existing conditions permitted. As a result, some Swedish orders have been placed in Derby and Germany, whilst at Norrahammar the much-needed space is available for the extension of the ironfoundry. Whilst mechanization is far advanced, there is still much automation envisaged.

Finally, the writer extends to Mr. C. G. Soderland his sincere thanks for his great help and close co-operation in preparing this account. He is also indebted to Mr. Thyberg, chief metallurgist, and Mr. L. Soderstrom, the foundry manager at Husqvarna, for their great help.

APPENDIX

Automatic Sand-plant at Norrahammar

By G. C. Söderbund

Mixers

The machine for premixing and premoistening the return sand—rather usual in plants of this kind—was rejected. Through this a machine that is quite expensive with regard to maintenance was avoided and at the same time work was saved. The unit was designed for three separate mixing sections; two of these are already built, with a total capacity of 40 tons of sand per hour. Each section consists of the following principal parts:

Return-sand hopper of 41 cub. yds. capacity; new-sand hopper of 6 cub. yds.; Bentonite hopper of 1.4 cub. yd.; coal-dust hopper of 1.4 cub. yd. capacity; a balance with measuring vessels; roller-mixer of the Simpson type; automatic-control

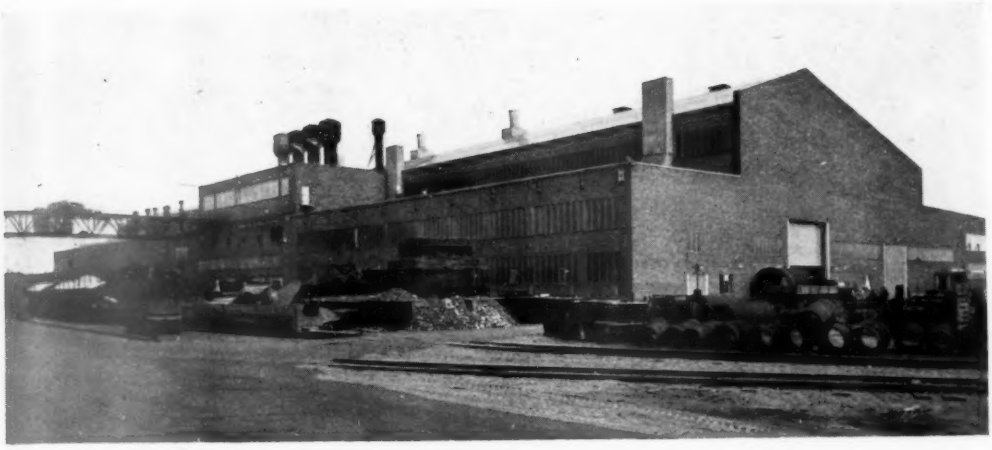


FIG. 9.—*External view of the Karlstads ironfoundry, showing the clean and pleasant appearance of the building. Some idea of the natural lighting utilized, may be gauged from the large areas of window space.*

device for mixes, and an automatic-control device for sand moisture.

The sand, details of which are given in Table I, is mixed automatically in the following manner, during mixing the next charge is prepared by means of the roller conveyor, which feeds a certain quantity of sand, fixed by the balance, into the measuring vessel. During this feeding, the moisture of the sand is measured and recorded automatically. New sand, which is also weighed, is then fed. The difference between the measured water percentage and that required, is determined. The balance of water is then added to a water hopper, above the mixer.

TABLE I.—*Moulding-sand Grain Distribution for the Automatic Plant. (Husqvarna Vapenfabriks)*

ASTM No.	Per cent. retained.
12	0.1
20	0.5
30	3.8
40	14.1
50	18.4
70	13.3
100	13.1
140	9.2
200	6.0
270	2.3
Pan	2.9

Clay content ..	16.3 per cent.
Carbon ..	8.5 per cent.
pH	9
Moisture ..	4.5 per cent.
Green strength	11.4 lb. per sq. in
Permeability ..	90 AFA
Shatter number	75

As soon as a charge has been discharged from the mixer, the balance vessel is opened, and return sand as well as new sand falls into the mixer. After this, coal dust and bentonite are added by means of small roll feeders placed under each hopper; these roll feeders are time-set to deliver a certain quantity of dust. Then, the bottom valve of the water hopper is opened and the water added.

Mixing is adjusted automatically by a timing roller, which facilitates an easy adjustment of the various time-intervals possible. At the moment the total cycle time is three minutes, but it can be adjusted to a minimum of two minutes and five seconds.

Moisture Adjustment

The principal obstacle to a fully-automatic sand-preparation plant has been the automatic determination of the water percentage of the return sand, and the supply of necessary water to balance

FIG. 10.—*The modern ablution facilities at the Karlstads ironfoundry are typical of those provided by many foundry concerns in Sweden.*

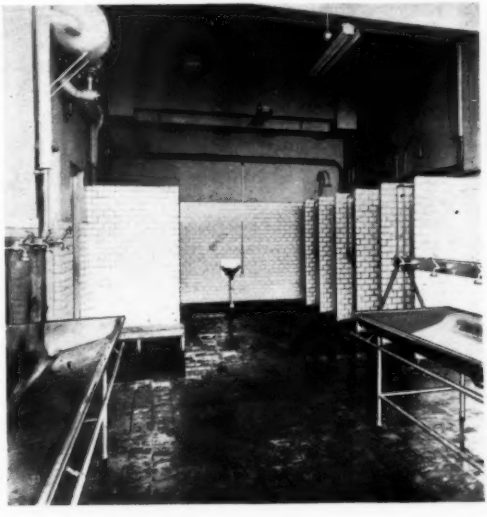


FIG. 11.—*In the canteen, the extensive use of plants, together with good natural lighting and ventilation provides pleasant surroundings for employees who use the facilities.*

that required. When making central-heating boilers, the sand is very dry, and in addition, shake-out is made intermittently, and therefore, the water content of the return sand varies within wide limits. This makes an automatic determination of the moisture even more difficult.

In the last few years, Americans have worked on these problems to a considerable extent, and it was decided to ascertain how far they had reached. The system used in the United States is based on the resistance principle, sand being regarded as an electrolyte. The ionic concentration of the sand varies with its percentage of clay, and accordingly the method presupposes that the return sand has a constant percentage of clay. However, this is certainly not always the case, and the measurements are therefore not definite. Moreover, the electrodes are fixed in the measuring vessel and the measuring can, therefore, give only a rough mean value of the moisture in the hopper. In addition, there is the problem of varying temperature of the sand, which can only be measured at one place in the hopper, which makes the value uncertain.

The plants studied by the writer in America worked satisfactorily, but the water content of the sand varied within relatively wide limits. When using this system, the instruments have to be controlled and calibrated quite frequently and their method was not found to be advantageous.

German Method

Fortunately, the Husqvarna foundry management came into contact with a German firm, which for many years had specialized in the building of plants for moisture determination, principally for the cellulose industry. This firm had had no former contact with foundries, but in spite of this they succeeded in solving the problem. The method now being used is based on capacity measuring. The apparatus consists of a generator for high-frequent current of two megaherz, with a rectifier, an amplifier and a measuring condenser. The condenser plates are situated where the sand from the return sand hoppers will pass on its way

FIG. 12.—*Two views of the heavy casting section at the Karlstads iron foundry showing (left) storage facilities for cores, in the foreground and (right) the large-capacity core stoves.*

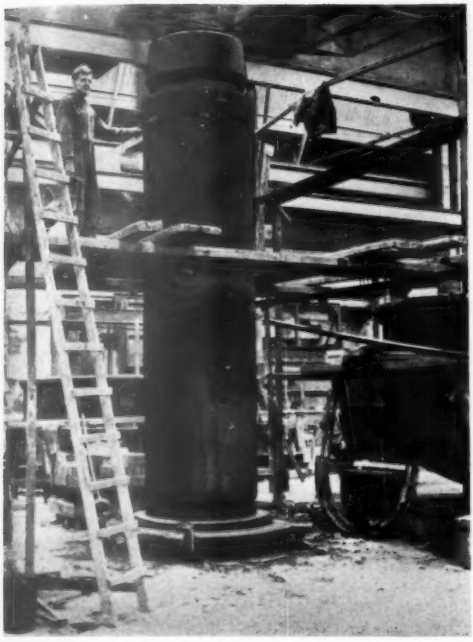


FIG. 13.—*Large core for a drying-cylinder casting for use in a paper mill, for which a permanent scaffolding is employed.* (*Karlstads Mekaniska Werksted.*)

to the measuring vessel (see Fig. 5). The capacity of the condenser depends on the dielectricity constant of the sand passing between the condenser plates, and the distance between the plates. The dielectricity constant of water is 80 and of sand and clay 2 to 3. If a constant height of sand is maintained, the capacity of the condenser varies with the water content of the return sand; every change in this results in an altered frequency, which is transferred to the rectifying part of the regulator. This high-frequency current is rectified, amplified and indicated on an instrument panel. The measuring values are passed on to the integral regulator and there they are further intensified. During the time that sand passes between the condenser plates, the regulator is constantly making a mean of all values obtained, this is compared with a value corresponding to the water percentage required (in this case 4.5 per cent.). The difference between these two values is transformed into a time impulse to the water valve, for the addition of water to the mixer.

Karlstads

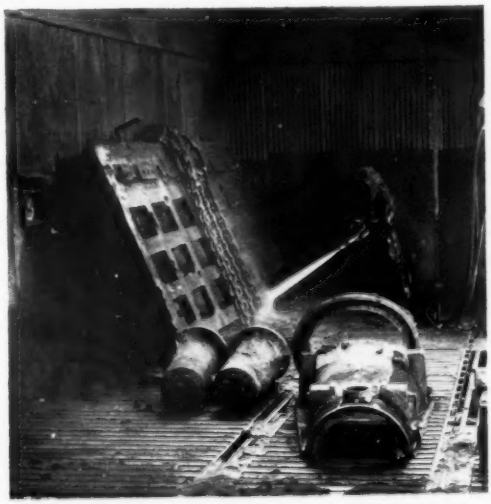
The foundry of Karlstads Mekaniska Werksted, in Sweden, is a department of a large engineering works which manufactures paper-making machines, water-turbines and similar productions. The parent company was established in 1860, but the present foundry was built in 1949. The buildings shown in Fig. 9 are of pleasing aspect and occupy an area of 132,500 sq. ft. It employs about 200 men (of whom about 80 to 85 are skilled) and no girls, except in the office and canteen. The men work a 48-hr. week and a skilled man will earn about £16. The shops are high, well ventilated, the atmosphere being changed three times per hour in winter and four times hourly in summer. The heating of the shops is by hot-water radiators, the heated water being supplied from an electric power-station about a mi.e away. Excellent washing, changing and bathing facilities have been provided (Fig. 10), as has also a large airy canteen (Fig. 11). The catering is in the hands of an outside contractor and its food and refreshments are sold to the men at something approaching cost price.

In the general layout of the works there is a generous provision of overhead cranes, which span the main shop (Fig. 12) at two different heights. These are supplemented by a number of electrically-operated wall jib-cranes, provided with "creep" speeds. Floor transport is by Clark fork-lift trucks and tyred wheelbarrows. Good use of the former is made in connection with disposing of surplus metal. This is poured into hinged metal-moulds, to yield standard-size pigs. When the metal is solid, the moulds are rotated and the pigs fall into a stillage for transport by the fork-lift trucks. Much of the sand is hand'ed by conveyors and elevators.

Raw Materials

The pig-iron and scrap arrives at a private siding, where they are unloaded by magnet into wheeled

FIG. 14.—*Hydroblasting being carried out on a large frame casting in the Karlstads foundry. This plant, which is thought to be larger than normally employed in this country, covers an area of approximately* 720 *sq. ft.*



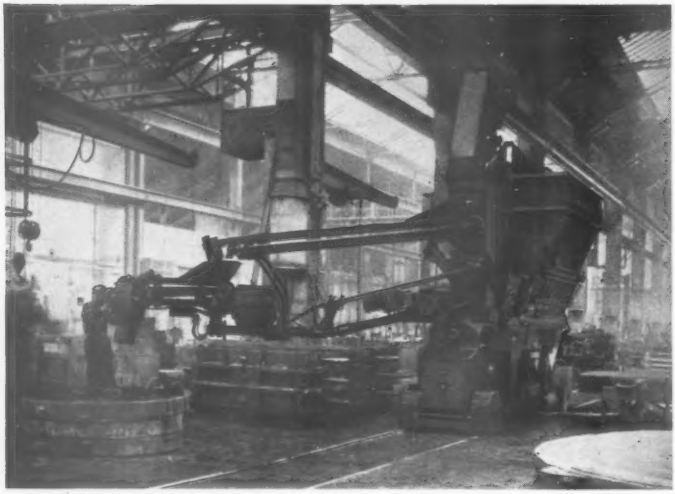


FIG. 15.—*Beardsley and Piper motive-type Sandslinger in the heavy-casting bay at the Karlstads ironfoundry.*

bogies which run into the melting shop. Here the metal is charged by hand into the charging skips resting on a weighing machine. These enter into a hoist, are elevated to charging-door level and discharged into the cupolas. There are four cold-blast cupolas, each having a capacity of 9 to 10 tons per hour. Limestone is handled by a grab, the coke wagons are emptied by means of a portable conveyor at the charging station or at the stockpiles and then transferred by baskets for elevation to the charging floor. This cupola plant is shortly to be replaced by a hot-blast system.

Sand Practice

It is generally accepted that cement moulding should be carried out in a shop quite removed from conventional green- and dry-sand practice. Yet, in this foundry, loam moulding, green-sand moulding, cement moulding, associated with self-hardening core-sand practice, are all carried out and, moreover, some moulds are of the composite type, the backing sand being "green" and the facing of the cement-sand mix.

The green sand is prepared in a plant by the Swedish Malcus concern. The new material, a local river sand, is transferred by a bucket elevator to a large overhead storage-bin. A second storage-bin is filled similarly from sand knocked-out from three stations in the foundry, reaching the boot of a bucket elevator by a steel-band conveyor. There is a third storage bin for other sand. The storage hoppers feed a Simpson mill, where Cummings coal-dust and bentonite are added. For the self-hardening core sand, the compound (which comes from Switzerland and is available in Great Britain) and river sand are mixed in a Fordath mixer. Each batch is quickly transferred to the coremaker in wheelbarrows and must be used up fairly quickly. About 60 per cent. of the cores in this foundry are made from the self-hardening mix. It has been in constant use now for several years and has cut coremaking costs by 40 per cent. The cores are dried at 200 deg. C., but drying times have been radically reduced. For blacking the cores, Durrans' material is used. Very large cores (Fig. 13), for a paper-drying cylinder, are swept up with bricks and loam, using permanent scaffolding as shown in the illustration. The drying stoves, which are oil-fired and of the air-recirculating type, are about 20-ft. wide, deep, and high. Some of the castings produced weigh up to 64 tons. For these a permanent runner box in the form of a maltese cross is brought into service for casting and the four ladles used have to discharge their contents in 90 sec.

A separate shop has been provided for ladle daubing and drying. A number of the ladles are of the teapot variety, but unlike the type which has a continuous air-cooled belt, a new feature in the form of an air-cooling slot is interposed between the gears and the ladle casing.

The firm's non-ferrous foundry is small and uses oil-fired Morgan Crucible Company's furnaces and pots, in addition to those of Swedish manufacture. Here, Mansfield sand is used to make a wide range of castings, including light-alloy castings, for the firm's assocated works.

Metallurgical Control

Four basic types of iron are made, apart from special irons using Vantit pig-iron and nickel, the latter usually added in the form of stainless-steel scrap. By careful weighing and good melting practice, the various charges are separated without the use of coke splits. The German coke used carries about 10 per cent. ash, but the quality is a variable. The laboratories, in charge of Glasgow-born Mr. Black, have a staff of about six. There is a chemical laboratory using both "wet" methods and a Hilger spectroscope; the sand laboratory uses the standard AFS apparatus supplied through Geo. Fischer of Schaffhausen. Preparation of test-pieces (many of which are cast-on) and tensile testing, etc., is carried out in a separate shop. Additionally, there is a microscopical laboratory.

Moulding

Cement-bonded moulding sand is prepared in pug mills, using 8 per cent. Portland cement. New sand is used sparingly in mould making as the backing sand consists of lumps returned from the shake-out. Excellent sand is made from the reclaimed

material coming from the Hydroblast plant (Fig. 14) by this system, the amount of sand to be carted away from the foundry each week is kept at a minimum. Even then, it is being used for the filling up and levelling off of waste ground nearby.

There is an increasing tendency in this plant to go over to core-assembly methods of moulding and Tabor machines of German, and more latterly, American manufacture are being used for core-making as well as for moulding. Much of the heavier green-sand moulds are rammed up by a motive-type Beardsley and Piper Sandslinger (Fig. 15). Hand moulding is aided by the use of pneumatic rammers; strickling of cement-sand is practised when making moulds for some semi-circular water-turbine segments (shown in Fig. 16). For these self-hardening cores (Fig. 17) are used. Some of the moulds made by the Sandslinger are faced with cement sand to give a better surface. Experience has taught to what degree separation of cement-sand from ordinary types can be effected.

Mould drying *in situ* is carried out either by Brown Boveri electric portable driers or by bottled propane. This is all part and parcel of the intense efforts being made in Northern Europe to reduce fume and dust in foundries, and the Karlstads foundry in fact has been visited by a delegation from the UK Factory Department of the Ministry of Labour and National Service to ascertain just what can be done in foundries under conditions of intense winter cold, which makes the problem much more difficult than our own climate.

Fettling

Reference has been made to the Hydroblast plant, which the writer believes to be larger than anything to be seen in Great Britain. There is also a Pangborn "Rotoblast" airless shotblasting plant which is giving good service.

Conclusions

The foundry is obviously a very-well-managed, progressive concern. Its progress is manifested by the fact that a new hot-blast cupola plant and new moulding machines are to be installed. It has pioneered Swedish practice in cement-moulding practice coupled with the intense development of the application of self-hardening cores.

The writer's thanks are warmly accorded to Mr. Aberg and his staff for help in the preparation of this article.

A.B. W. Dan Bergman

The firm of A.B. W. Dan Bergman, generally known as Wedaverken, at Sodertalje, some 20 miles south-west of Stockholm, is the largest light-alloy foundry in Sweden. In addition to the aluminium sand and die-casting and magnesium shops, there are a forge, extrusion plant and machine shops. The whole works employs some 600 people, including a modicum of female labour. Of these, some 250 are engaged in the various foundries, which turn out some 2,000 tons of aluminium and 100 tons of magnesium castings each year. The aluminium castings produced range between 16 cwt. down to a few ounces.

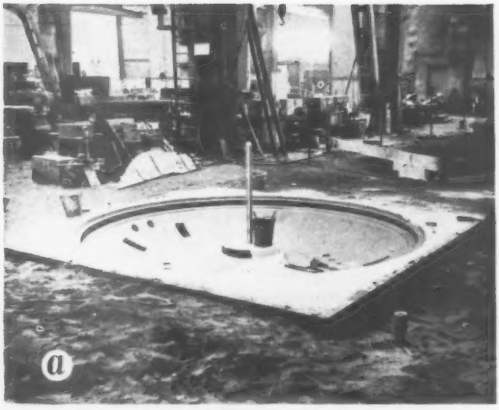
The raw materials reach the foundry in standard railway trucks which have been transported from the sidings on a 16-wheeled bogie of Italian manufacture. The aluminium ingots are stacked in the open air and fork-lift trucks are used to take them to the melting furnaces. In general, oil fuel is employed for melting, and use is made of a Sklenar 25-cwt. furnace and crucible plants.

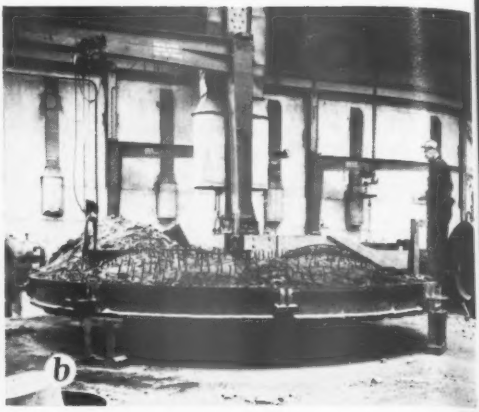
Mechanized Plant

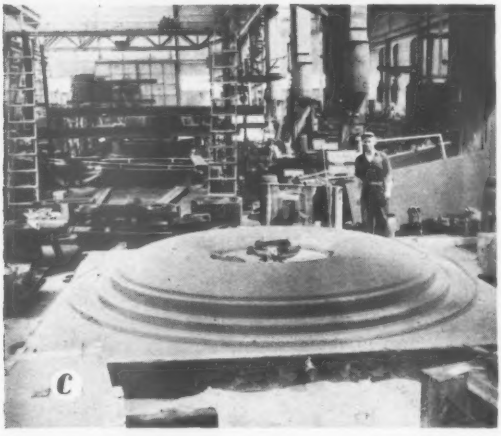
The mechanized plant appealed to the writer as being extremely efficient and adaptable. On a floor above a Westin and Backlund fully-automatic, press-button-controlled, machine is the pattern storage. Each morning, the patternplates, to be used during the day, are placed on a length of inclined gravity roller-pathway and the moulder is provided with a programme showing the number of moulds to be made off each. When a new pattern is required, pressing a lever sends the no longer required pattern up aloft, where it is automatically pushed off to a roller pathway opposite to the supply conveyor and replaced by a fresh one. This operation takes between 20 and 30 seconds. The moulding machine (Fig. 18), which will be the subject of a future article, is known as the A.F.A. 38 and has electro-magnetic control for sand feeding, jolting and rollover, and pneumatic control for other features, using eight circulating patternplates, and produces a half-mould every 20 seconds.

There is a good arrangement of roller pathways and as aluminium castings need variable times, for coring up, lengths of them can be pulled out of the

FIG. 16.—*Water-turbine mould strickled in cement sand, showing core-placing in progress.* (*Karlstads Mekaniska Werksted.*)







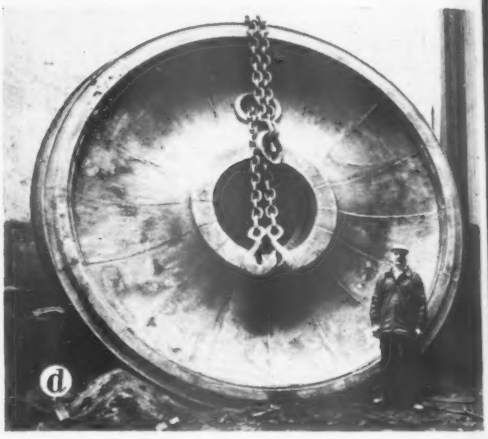


FIG. 17.—*Stages in the production of an end-cover casting in the Karlstads ironfoundry; (a) preparing the bottom section of the mould; (b) strickle forming the top section; (c) top section of the mould, ready for final assembly; (d) finished casting, and (e) typical large core, produced at Karlstads, with a self-hardening binder; drying is completed within from 1 to 4 hours at a temperature of 200 deg. C.*

line, without hindering production for lengthy core-setting. After casting, the boxes are knocked out, the castings put into stillages, and the steel boxes of German origin are returned to the machine. Sand is supplied to the machine from an automatic plant by Foundry Equipment, Limited, but differing from the conventional, as it includes a Speedmuller; Foundry Equipment, Limited, have also furnished a sandrammer plant. In addition, there is a short line of what appeared to be Tabor machines.

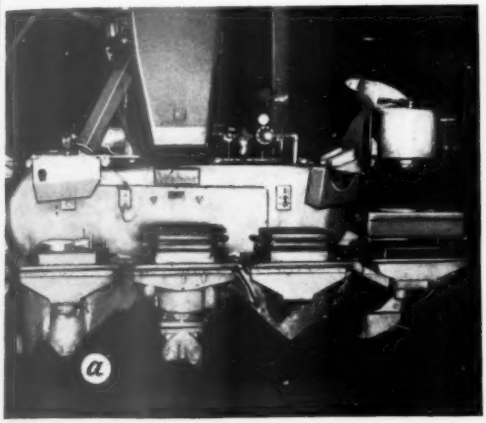
The fettling and inspection shops (including X-ray) are much the same as one would find in an up-to-date shop in this country. Both the CO_2 Process and shellmoulding are practised, the former

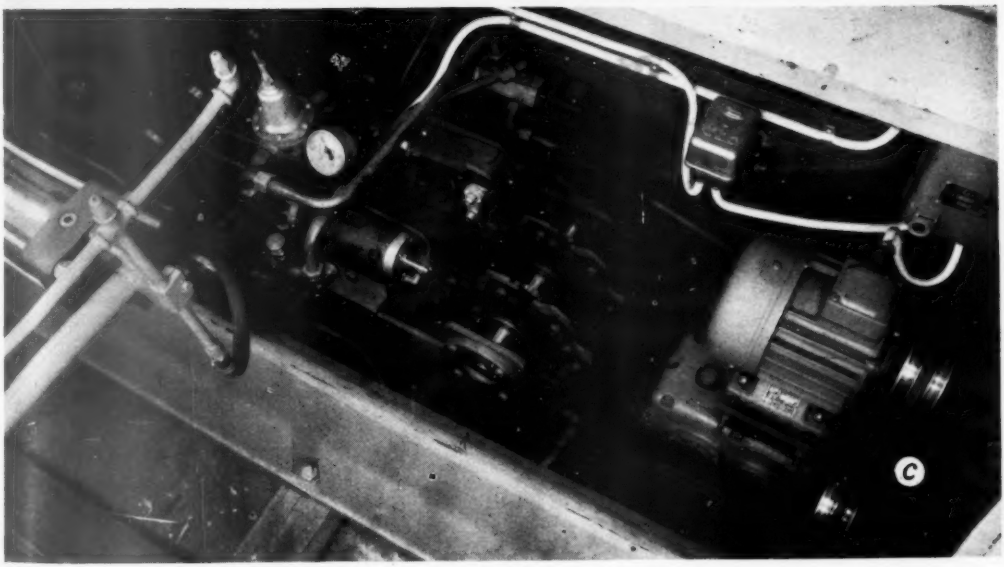
being used for cores for the die-casting shop and the latter for a range of central-heating pumps of which some 20,000 are made each year. All the usual type of alloys, including 12 per cent. silicon alloy, are produced and all are compounded in the works—no alloyed ingots being bought.

The writer did not visit the magnesium foundry owing to lack of time but was assured that it was of the conventional type. The die-casting foundry used holding furnaces which were heated by electric resistance—the pots being of mild steel.

Grinding and finishing of the magnesium castings is carried out in a unique plant—each machine, usually using powered hand tools, is furnished with an easily-adjustable flexible, strongly-exhausting pipe brought as near as possible to the point of working. The fine powder and chips pass under the shop floor to a position located under each machine and terminate in a box. Above this box, and enclosed, are a series of cones, down which cascades a stream of water. Most of the powder settles in the box from which it is removed from

FIG. 18.—*Three views of the Westin and Backlund, fully-automatic press-button-operated moulding machine in use at the works of A.B. W. Dan Bergman, a Swedish light-alloy foundry: (a) Front view of the machine, showing four stages in the moulding cycle; (b) discharge side, showing a completed mould being pushed on to the roller-conveyor system by a hydarulic ram, and (c) the chain-driven, cam-operated controls for the hydraulic mechanisms.*





Scandinavian Foundry Review

time to time. A little is carried over to one of two quite large settling tanks, the water in which is treated with an alkali to prevent the evolution of hydrogen. A portion of the powder is sold to firework manufacturers, but the bulk is burnt in the open air.

Amenities provided by the management are of the high order one expects in Swedish foundries; lockers adjoining the bathing rooms are of the forced-ventilation type so both drying is effected and stuffiness avoided. The canteen provides excellent food and each man is served in approximately ten seconds. Most of the men drink milk with their mid-day meal and though the establishment is licensed, only one man was noticed to prefer beer.

This foundry has been making extensions each year; the next scheduled addition is the construction of a central coreshop. Lighting and ventilation are more than adequate and are coupled with excellent heating facilities, however despite these working conditions, the management finds it difficult to get apprentices.

The writer wishes to thank Mr. Urban Molin, works manager of A.B. W. Dan Bergman, for his help in the preparation of this article.

(To be continued)

Contracts for Mitchell Engineering

Three contracts with a total value of about £2,000,000 have been awarded to Mitchell Engineering, Limited, Peterborough, for the installation of mechanical handling equipment. The biggest contract—worth just under £1,000,000—was given by the Steel Company of Wales, Limited, for new plant and extensions to equipment already in operation. This plant forms part of the raw materials conveying system for handling coal, coke, ore, and limestone which are required for a new blast furnace at Margam. Twenty-three new conveyors and extensions to six existing Mitchell conveyors will be supplied, making a total length of 6,500 ft. and capacities of up to 1,000 tons per hour.

The second contract was awarded by Stewarts and Lloyds, Limited, Corby (Northants), for an ore-crushing plant incorporating a comprehensive system of belt conveyors, screens, tertiary crushing units, and storage bunkers. An associate company, the Mitchell Construction Company, is carrying out the civil engineering work on this contract.

Mitchell Engineering will also supply an ore-crushing plant for the Stanton Ironworks Company, Limited, Nottingham. Equipment for this contract will include wagon haulage and tipping systems, primary and secondary ore-crushing units, and interconnecting belt conveyors, cranes, and associated plant.

CONTRACTS valued at $150,000 for the supply of steel shuttering for the Beauharnois Lock on the St. Lawrence Seaway project have been secured by Acrow (Canada), Limited, an associate of Acrow (Engineers), Limited. The Canadian company was recently awarded a $200,000 order for steel formwork for the Warsak Dam.

Tin Research Institute

Silver Jubilee Celebrated

To celebrate the Silver Jubilee of its founding, the Tin Research Institute last week invited visitors to inspect its laboratories and meet the staff. Whilst its financing differs from the great national research associations, it gives to users of tin, exactly the same type of disinterested service, but with no priority being granted to "members," when new developments are disclosed, as the only members are the actual tin producers. In an extremely well-written history of the Institute "Tin Research, 1932-1957," Dr. E. S. Hedges in one paragraph discloses how high a ratio of the work undertaken has a bearing on various phases of foundry practice. The paragraph reads: "To name some of the more important industrial applications, tin is used with copper in bronzes and gunmetals, with lead in solders, with antimony and copper in bearing alloys and pewter, and with lead and antimony in type metals. It is used as a non-toxic, corrosion-resistant coating on steel, especially as tinplate and also on articles of cast iron, copper and brass, particularly for food-handling equipment. In the form of chemical compounds, it is used in vitreous enamelling, silk, soap, paints and plastics."

Thus, the ratio is both high and important. For example, research work has now been completed and is being applied industrially for the continuous casting of solid and hollow bronze rods and other sections. In the apparatus developed by the Institute, a dovetailed steel section placed in the base of a water-cooled mould grips the solidified bronze and slowly and mechanically moves downwards, the solidified metal forming a rod of increasing length. Using a similar method for tube manufacture, the wall thickness can be controlled within very narrow limits, whilst both the internal and external surfaces are excellent. It is interesting to note that a film of this process is available for showing to technical audiences.

Good progress has been reported on the improvement of the tinned surface of iron castings, through the use of an inch-thick layer of molten flux on the metal bath, in a process known as the "direct chloride" method. Metallographic methods developed at the Institute are of interest to founders, as in many cases there is encountered the problem of preparing for surface examination of very hard and very soft metals in contact with each other.

In the course of years, the staff of the Institute has grown to over 50. The laboratories are excellently equipped and the staff are obviously well versed in industrial problems. Finally, the Tin Research Institute has made, and is making, a noteworthy contribution to the improvement of foundry processes.

IBF Conference—Highlights

Asked for "highlights" of this year's conference of the Institute of British Foundrymen, at Harrogate, one of the prominent officers of the Institute has recorded the following: (*a*) The quality of Marin Lord's coloured slides illustrating his paper, "Production Problems in the Manufacture of Alloy-iron Castings;" (*b*) the confidence with which Modern Foundries, Limited undertook the casting of a heavy machine-tool component to a strict time schedule in front of 50 spectators—a nerve-racking ordeal for any management; (*c*) routine CO_2 process moulding and basic-cupola operation as established at J. Blakeborough & Sons, Limited, and (*d*) the true commercial implementation of shell-moulding on a major scale at E. Green & Son, Limited (Wakefield), and Hepworth & Grandage, Limited (Bradford).

Company News

CHURCHILL MACHINE TOOL COMPANY, LIMITED—The company proposes to make a scrip issue on the basis of one 5s. share for every 15s. ordinary stock held.

HICK, HARGREAVES & COMPANY, LIMITED—The company is paying 18½ per cent. for the year to March 31, 1957, with a final dividend of 10 per cent. and a bonus of 3½ per cent. This represents an effective increase of 1½ per cent. over the previous year's distribution. Net profit, after tax, is £330,519 (£294,829).

SHEFFIELD STEEL PRODUCTS, LIMITED—Capt. W. M. Hungerford Pollen, the chairman, states that the company was able to increase its turnover sufficiently to earn a little more in spite of lower profit margins, thanks to increased productive capacity. The main problem is how to keep selling prices steady while costs continue to rise and still show a reasonable profit on turnover.

PLATT BROS. & COMPANY (HOLDINGS), LIMITED—The company, which has acquired all the outstanding stock of Prince-Smith & Stells, Limited, now holds 93.2 per cent. of the 5 per cent. cumulative preference stock and 87.4 per cent. of the ordinary stock in Textile Machinery Makers, Limited, and 68.4 per cent. of the ordinary and 84 per cent. of the "A" ordinary in Tweedales & Smalley (1920), Limited.

BIRFIELD, LIMITED—The company will advantage holders of both the £2,000,000 6 per cent. unsecured loan stock, 1976-81, and the recent issue of £1,500,000 of like "A" stock if the two issues are "completely assimilated and treated as one issue for all purposes, including stock exchange quotation and dealings." A resolution enabling the "A" stock to be assimilated with the earlier stock is to be considered at a meeting of original holders on July 22.

GEORGE COHEN 600 GROUP, LIMITED—Consolidated profits in the year to March 31, 1957, rose sharply, and the dividend is increased by 1 per cent, to 12 per cent., less tax. The final dividend is 8½ per cent. on the £3,125,000 ordinary capital as increased by a one-for-four rights issue at 8s. 6d. per 5s. share. The unchanged 3½ per cent. interim was paid on the former capital. At the time of the issue a final of 7½ per cent. was foreshadowed. Group net profit is £1,097,686 (£889,991).

BUTTERLEY COMPANY, LIMITED—After payment of the capital distribution of 8d. per share, the balance still available for distribution in cash was £115,228, said the chairman, Mr. M. F. M. Wright, on July 5 at Ripley. There was a possibility of a further amount being added to this figure from the surplus arising on the nationalization of the coal-mining interests, after the company had agreed with the Inland Revenue what portion of the £1,900,000 balance of compensation could be distributed in cash. It was not yet possible to forecast what the addition would be.

RUSTON & HORNSBY, LIMITED—With the order-book at a higher level than a year ago, the chairman, Mr. W. J. Ruston, hopes that the current year's results will compare favourably with those of the past year to March 31. In spite of the cessation of practically all business to most of the important Middle East markets, exports continue to represent about 70 per cent. of the turnover. Demand elsewhere showed a healthy increase. Orders have been obtained for diesel generating sets for the British Navy's first atomic submarine, and the nuclear energy department is being progressively strengthened, adds the chairman.

HORSELEY BRIDGE & THOMAS PIGGOTT, LIMITED—Agreement has been reached in principle as to the basic terms of an offer to be made by the company for the acquisition of the whole of the £150,000 issued ordinary capital of Mechans, Limited, constructional engineers, of Glasgow, W.4. The consideration is one new 10s. ordinary in the company, ex any dividend to be declared for the year to March 31, 1957, for every four ordinary 5s. shares cumulative dividend, in Mechans. The company will guarantee the £125,000 preference of Mechans, both as to dividend and to capital. Horseley Bridge has in issue £430,000, of which £370,000 is in ordinary.

RICHARDSONS, WESTGARTH & COMPANY, LIMITED—Group profits increased by 12½ per cent. to £1,204,219, before tax, in the year to March 31, 1957, reflecting a larger volume of concluded contracts. The nine months' profit of the Humber Graving Dock & Engineering Company, Limited, acquired as from July 1, 1956, was £154,109, before tax, or approximately at the same rate as in its previous year. In the forthcoming annual review a consolidated accounting statement will be included incorporating Humber Graving and the recently acquired Parsons Marine Turbine Company, Limited, for the whole of the past year, so as to give a view of the group as now constituted.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

774,798. Harry W. Dietert Company, 9330 Roselawn Avenue, Detroit, 4, Michigan, USA.

A method of making a shell-type mould. A mixture of sand and a binder is forced so as to fill completely the free space between two separable container parts. One of these is a cold pattern supported in a cold mould box. The other is a cold dryer-plate of a shape conforming to that of the pattern. It is placed so as to provide a free space, corresponding to the mould section to be formed. One of the advantages of the invention is that the sand is wet and is, therefore, not the usual dusty process. Inexpensiveness is also claimed since quick-drying oils may be used, and conventional blowing equipment utilized.

775,041. Fairbairn Lawson Combe Barbour Limited, Wellington Foundry, Leeds, 1, Yorks.

A shell-mould making machine. It has a heated oven, having a table or rack inside capable of receiving patterns and also capable of occupying a number of positions in regard to the oven door. In front of the door is a combined roller-track and ejector mechanism.

On each side of the track is a dump box, together with pattern locating arrangements on each dump box, so that a single pattern may receive an investment from each dump box in succession. This is in order to give the pattern firstly a layer of fine-grained sand (a short application); and secondly, a coarse-grained sand and resin layer to give strength and porosity.

Also, **775,132.** This invention concerns a method whereby elaborate or branching cores can be produced accurately and cheaply by a blowing operation, in the shell-moulding process. The parts of the finished core-assembly are placed in a hollow, heated core-mould, having the shape of the finished core. The parts are then combined to form a whole by blowing a sand/resin mixture into the mould, in such a way as to form a final part and to cause the other parts to adhere to one another.

News in Brief

THE FOURTH INTERNATIONAL AUTOMATION EXPOSITION is to be held at the Coliseum, New York, from June 9 to 13, 1958.

THE SELSON MACHINE TOOL COMPANY, LIMITED, announce that their new address is 41 to 45 Minerva Road, North Acton, London, N.W.10. (Telephone: Elgar 4000).

STEWARTS AND LLOYDS, LIMITED, with associated and subsidiary companies, are to exhibit a wide range of their steel tube products at the British Trade Fair to be held at Helsinki, from September 6 to 22.

THE SOCIETY OF INDUSTRIAL RADIOLOGY and Allied Methods of Non-destructive Testing, 2 Tomswood Terrace, Barkingside, Essex, has changed its name to the Non-destructive Testing Society of Great Britain.

THE DOHM GROUP, of Victoria Street, London, S.W.1, is now offering a complete refractory and thermal insulation service to industry, with a mobile team of experts prepared to travel to any part of the country at short notice.

A NEW APPRENTICE TRAINING SCHOOL and educational department at the Nobel division of Imperial Chemical Industries, Limited, Stevenston (Ayrshire), was opened on Thursday of last week by Sir Ewart Smith, a deputy chairman of the company.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY held a reception at Grosvenor House recently to enable guests to meet Mr. Guy J. Coffey, president of the Chicago Pneumatic Tool Company of New York and chairman of the host company.

THE BURNS & LAIRD LINES STEAMER Lairdshill has left for Dublin to be broken up. The vessel, of 1,776 tons gross, was launched by Ardrossan Dockyard in 1920 and her machinery, of 3,000 h.p., was the work of J. G. Kincaid & Company, Greenock.

THE Metropolitan-Vickers Electrical Company, Limited, through its South African associates, has received an order for 135 electric locomotives for the South African Railways. Total value of the order, including spares and drawings, is said to be £7,643,800.

FORTY-SEVEN EMPLOYEES of Frank Wigglesworth & Company, Limited, engineers and millwrights, Clutch Works, Hurstwood, Shipley, have completed 25 years' service or more. The directors of the firm on July 5 entertained them and their wives to dinner at Shipley Musical Union Rooms.

RUBBISH charged into the top of a slag pot was responsible for the explosion which occurred in the melting shop at the Templeborough works of the Steel, Peech & Tozer branch of the United Steel Companies, Limited, Rotherham, recently. The accident killed one man and injured six others.

LEOPOLD LAZARUS, LIMITED, iron and steel merchants, etc., of London, E.C.1, has been appointed sole representative in Great Britain of the National Steel Corporation, of Pittsburgh, United States, comprising the Great Lakes Steel Corporation, the Weirton Steel Company, and the Hanna Furnace Corporation, etc.

BECAUSE OF the substantially increased costs of manufacture and distribution, the price of all Portland cements has been raised, announce the Cement Makers' Federation. The price variation will not be the same at all points of delivery, but the average increase throughout the country will be approximately 7s. per ton.

IT IS REGRETTED that in connection with the report on the visit of the French Master Patternmakers Society to the works of H. C. Hopper (Kingston) Limited, a demonstration of a new patternmaking material was attributed to Shell Mex and B.P. Limited instead of to Shell Chemical Company Limited, 170 Piccadilly, London, W.1. (JOURNAL, June 13, page 731.)

A CONTRACT worth nearly £750,000 has been received by the Tube Investments subsidiary, Talbot Stead Tube Company, Limited, Walsall, from C. A. Parsons & Company, Limited, Newcastle-upon-Tyne, (a member of the Nuclear Power Plant Company, Limited), for specialized atomic-reactor components for the Bradwell Nuclear Power Station in Essex.

THREE FIRMS have contributed towards the cost of equipping the metallurgical laboratories at King's College, Newcastle-upon-Tyne, shortly to be rehoused in the John Line Building. C. A. Parsons & Company, Limited, has given £500, Imperial Chemical Industries, Limited, £400, while British Paints, Limited, has given a large edge-runner mill.

WORK IS EXPECTED TO COMMENCE in the near future on an extension to the Kidsgrove (Staffs) works of the English Electric Company, Limited. The extension will provide extra production space, needed to meet the general expansion of the company, provide better facilities for social activities, and lead eventually to a bigger labour force. The Kidsgrove works is the headquarters of the company's control and electronics department.

OF AN APPROXIMATE TOTAL of 1,900 employees of Keith Blackman, Limited, 233 have served the company for 25 years or more and they have received inscribed wrist-watches as tokens of appreciation. The presentations (165) at the London head office and works were made by Mr. D. S. Woodley, chairman and managing director; at Arbroath (53) by Mr. W. G. Calder, director and works manager, while the remaining awards were made to representatives at the various branch offices and London area sales office.

APPLICATIONS FOR MEMBERSHIP of the British National Committee for Non-destructive Testing are invited from appropriate institutions or societies. The subscription is 5 guineas per annum. Each member society will be asked to nominate a representative who would take part in meetings of the National Committee. Applications, for the time being, should be made to the secretary of the Joint Committee on Materials and Their Testing, Mr. R. Main, A.M.I.MECH.E., at 1, Birdcage Walk, Westminster, London, S.W.1.

BRITISH TRANSPORT COMMISSION announce that because of further heavy increases in working costs, British Railways' charges for freight traffic (except small consignments by goods train chargeable at the recently published scales) will be increased by 10 per cent. as from August 1. To enable this to be fully effective the Commission propose to make use of the special statutory procedure for temporary authorization of an increase in the maximum charges fixed by the Railway Merchandise Charges Scheme.

ORDERS FOR 753 RAIL TANK CARS, valued at £1,250,000, have been given to three British companies by the Esso Petroleum Company, Limited. Hurst, Nelson & Company, Limited, Motherwell, is to supply 314 of the vehicles; Charles Roberts & Company, Limited, Wakefield, will supply 315; and the Cambrian Wagon and Engineering Company, Limited, Cardiff, 124. The vehicles will have a maximum gross load of 35 tons and will be fully equipped to meet the requirements of the British Transport Commission's modernization scheme.

FULL-TIME WORKING has been resumed at the Wolverhampton works of Henry Meadows, Limited, petrol and diesel engine and gear-box manufacturers, by most of the 750 production workers who were put on a four-day week two months ago following the suspension of a £500,000 contract for the supply of diesel generating sets to the Egyptian Government. Fifty fitters were recently discharged as redundant. Some of the workers affected by the short time arrangement have since found other employment.

THE PARKFIELD WORKS of Ashmore, Benson, Pease & Company, Stockton-on-Tees, have installed a new £17,000 ablutions block, which includes ten tiled showers, four footbaths, and a large changing and clothes-storage room. The facilities are available for some 250 men, who each receive a bar of soap and clean towel weekly at a cost of 3s. to cover laundry and replacement charges. One-third of the foundry workers are using the facilities, and it is hoped that their example will be followed by the others.

ORDERS WORTH MORE THAN £60,000 for equipment for nuclear power stations have been announced by Birlec, Limited of Erdington, Birmingham. The firm has also received orders for a batch of eight special furnaces for the Atomic Energy Authority's industrial group headquarters. For the experimental power project at Doureay, Birlec are to supply air-drying plant for the fast reactor sphere. Other drying equipment is to be installed at the nuclear power stations being built at Berkeley, Glos, and in the south of Scotland.

METALLURGICAL ENGINEERS LIMITED, Cannon Street, London, E.C.4, have obtained an order for five oil-fired air heaters for the new copper and nickel smelter of Eastern Mining & Smelting Corporation, Limited. The new plant is being erected at Chicoutimi, Quebec. The consulting engineers are Arthur G. McKee & Company, of Canada, Limited, Cleveland, Ohio, and the order was obtained in the face of fierce American competition. Each heater has a rated capacity of 5,000 cub. ft. per min., at standard temperature, heated from — 35 to 650 deg. C., with a thermal efficiency of 79 per cent.

SEVENTEEN FAMILIES of miners and steelworkers of the six Community countries visited Luxembourg at the invitation of the High Authority of the European Coal and Steel Community from July 7 to 11. The families, selected from among the 2,000 in the Community, undertook to keep, for a period of a year, household accounts covering all their receipts and expenditure. Each family comprising the parents and two children 13 to 14 years old, had been chosen jointly by the national institutes of statistics of the Community countries, and the statistics division of the High Authority.

THE BOARD OF TRADE announce that the Open General Licence will be further amended with effect from August 1. The effect of these amendments is that from that date goods, of a description specified in the annex to this notice, may be imported from any source without an individual licence. Amongst goods not previously so admissible are the following which have interest for the foundry industry: Dolomite; fluorspar; Fuller's earth; graphite crucibles; magnesite; antimony; bismuth; calcium; chromium; copper; lead; magnesium; tin; vanadium; zinc; zirconium; olivine rock; silicon; silica; tellurium; and vermiculite.

SUNKEN METAL, which has lain on the sea-bed off the Irish coast for 60 years, will be salvaged by British foundry experts this summer. The Southampton steamer, Help, with a team of deep-sea divers and metallurgists on board has already arrived off the South coast and is using "Asdic" to locate wrecked steel steamers which were torpedoed by German submarines in the first world war. In addition to iron and steel the wrecks contain valuable bulks of steel, copper, lead and other metals. Operations will take place in the 100 sq. miles area, which extends from the Fastnet Rock, Co. Cork, to Tuskar Rock, Co. Wexford.

NEW MODERN-STYLED OFFICES were opened recently by the Clyde Crane & Engineering Company, Motherwell, which is controlled by the Newcastle firm of Clarke, Chapman & Company, Limited. The building is steel framed, with concrete floors and roof, and has Asbestolux hung ceilings throughout. The outer walls are built in sandfaced brick with rough finished concrete base course and window surrounds. On the ground floor is the entrance vestibule, reception and staircase hall; board room, offices, stores, and toilet accommodation. The upper floor contains the drawing office with working space for 30 draughtsmen. The heating scheme consists of an accelerated low-pressure hot-water installation and a tempered-air ventilation system, complete with air filter and washer.

Mr. CHARLES HERVEY of the United Steel Companies, Limited, was the speaker at the luncheon of the Non-Ferrous Club, held in Birmingham on July 4. In his talk entitled "Putting in the Picture" he emphasized the value of public relations, saying that it was essential for any organization to maintain good relationships with adjacent groups, including customers, competitors, employees, and Trade Unions. It was important that the confidence of employees be obtained as they were the firm's ambassadors at large, there was, he said, much diffidence in British industry on this point. He also emphasized the value of the trade and technical Press in carrying news of achievements of individual companies into wider circles. At the meeting a collection was taken on behalf of the Royal Metal Trades Pension and Benevolent Society, which yielded £13.

Obituary

The death is reported of Mr. JOHN H. LOUDEN, chairman of Pegler & Louden, Limited, brassfounders and engineers' merchants, Brown Street, Glasgow, at the age of 76.

Mr. GEORGE MAURICE WILSON, who retired a year ago from his post as cashier for the Brightside Foundry and Engineering Company, Limited, Ecclesfield, Sheffield, has died at the age of 66.

The death occurred on July 8 of, of Mr. LUTHER FEATHERSTONE, at the age of 63. He had been with Prince-Smith & Stells, Limited, worsted machinery makers, of Keighley, for 47 years, having held position as chief draughtsman and works manager.

The death has occurred of Mr. A. G. HENSHAW, a director and works manager of Charles Roberts & Company, Limited, Horbury Junction, near Wakefield. He joined the firm in 1924 as chief civil engineer, was appointed works manager in 1930, and elected to the board six years later.

The death is recorded at the age of 83, of Major W. G. WILSON, founder and a director of Self-Changing Gears, Limited, Coventry, an associate company of Leylands Motors, Limited. He was the inventor of the epicyclic gearbox, and in 1918 was created a C.M.G. for his work in connection with the initiation of a cross-country vehicle, later developed into the tank.

Personal

Mr. J. H. JOLLY has retired from the board of John Lysaght, Limited.

Mr. J. C. CALLOW has been appointed chief accountant of Stewarts and Lloyds, Limited, as from September 2.

Mr. H. G. JENKINS is not seeking re-election to the board of Renold Chains, Limited, at the annual meeting on August 1.

Mr. F. BURNS RICHARDSON, joint managing director of M. & C. Switchgear, Kirkintilloch, has retired after 46 years' service.

Mr. WILLIAM BULLOCH, works manager of Cruikshank & Company, Limited, Denny, has been appointed to the board of directors.

Mr. L. D. ROPER has been appointed sales manager of Williams Alexandra Foundry, Limited, bronze founders of East Moors Road, Cardiff.

The Board of Trade announce that the President has appointed Mr. ELKAN SIMONS, F.I.C.D., to be a member of the Council of Industrial Design.

Mr. F. B. MCPHERSON, general manager of the Kilmarnock factory, has been elected an additional director of the Glacier Metal Company, Limited.

Mr. JAMES SMITH, who has been general manager of United Fireclay Products, Limited, since 1949, has been appointed to the board as managing director.

Mr. JOHN T. WELLS, has left the foundry department of Edgar Allen & Company, Limited, on his appointment as the firm's senior representative in South and West Yorkshire.

Mr. D. CRAIG has been appointed melting shops superintendent of Steel, Peech & Tozer, Limited, in succession to Mr. J. T. BROOKES, who has retired after 50 years' service.

Guest Keen Iron and Steel Company, Limited, announce that following the retirement of Mr. J. H. JOLLY, Mr. K. S. PEACOCK has been elected chairman of the board of directors.

Mr. H. R. NEWMAN, general manager of the engineering section of Butterley Company, Limited, Ripley, has been appointed joint managing director of the firm, with Mr. R. HERMON.

Lancashire Dynamo Group announce that Mr. A. J. C. MACLEOD, A.M.I.E.E., has been appointed export manager and Mr. PETER H. JACKSON, M.C., has been appointed an assistant sales manager.

Mr. R. IVOR SLATER has been nominated a director of Buckley and Taylor Limited (a subsidiary of Brightside Engineering Holdings Limited), and Mr. A. JENKINSON has been appointed secretary.

Mr. J. R. NUTTALL has been appointed secretary of the Brightside Foundry and Engineering Company, Limited, in succession to Mr. R. I. SLATER, a director, who is resigning as secretary of the company.

Mr. J. H. RIVERS, chief designer and technical director of Craven Brothers (Manchester) Limited, retired at the end of last month. His services, however, are being retained in a consultative capacity.

Mr. ANDREW BLYTH, a director and general manager of William Mills, Limited, has been appointed managing director as from August 1. He succeeds Mr. J. F. PAIGE, who retires at the end of this month.

Mr. H. W. FULTON has been appointed an executive director of the North British Locomotive Company, Limited, in control of the manufacture of all North British/M.A.N. diesel engines. He was formerly managing director of Albion Motors Limited.

Mr. W. T. GILL has been appointed chairman and Mr. W. A. ROBOTHAM has been appointed managing director of Sentinel (Shrewsbury), Limited. They succeed Mr. J. T. RYMER who has resigned from the board to facilitate the integration of the company's resources with the Rolls-Royce group.

Mr. JOHN J. SHEENAN, managing director of the Coneygre Foundry, Limited, Tipton, Staffs, is retiring from that position at the end of July. Mr. Sheenan is president of the British Cast Iron Research Association and a past-president of the Institute of British Foundrymen. He proposes to farm in Ireland.

Mr. R. A. MILLER, a director of Foundry Services, Limited, Nechells, Birmingham, is to perform the official opening ceremony of the new associate of the company, Foundry Services (Japan) Company, Limited, at Ashimori, Okayama-Ken on November 15. Mr. Miller's autumn journey will be his fourth to Japan in the past two years.

Mr. JOHN PATERSON has been presented with a television set by Charles W. Ireland & Son, engineers and scrap metal merchants, Hamilton, for his 30 years' service with the firm as transport manager. Presenting the gift, Mr. Duncan Ireland told how Mr. Paterson had been the firm's first member of the staff, joining soon after it was founded in 1926.

Mr. H. A. J. SILLEY is retiring from the board of Stothert and Pitt, Limited, in view of the increasing amount of time taken by his other interests. Mr. W. C. KINDER, chief engineer, is retiring on August 31, and will be succeeded by Mr. T. E. R. TORRANCE. The company has also established a new research and development department under the control of Mr. N. E. KERRIDGE.

GROUP CAPTAIN GORDON SLADE has been appointed superintendent of flying of the Fairey Aviation Company, Limited. He will be responsible to the chairman for the co-ordination of all flying activities, within the company. Group Captain Slade joined the company as chief test-pilot in 1946. MR. PETER TWISS, who also joined the company in 1946, succeeds Group Captain Slade as chief test pilot.

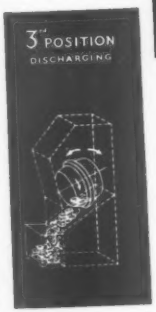
Mr. N. L. G. LINGWOOD, distribution director of British Oxygen Gases, Limited, has been re-elected president of the British Acetylene Association. Mr. Lingwood, who is also a member of the Institute of Welding and an associate member of the Institute of Mechanical Engineers, joined British Oxygen in 1923 and was appointed as director of sales at Bridgewater House in 1945, and commercial executive in 1953.

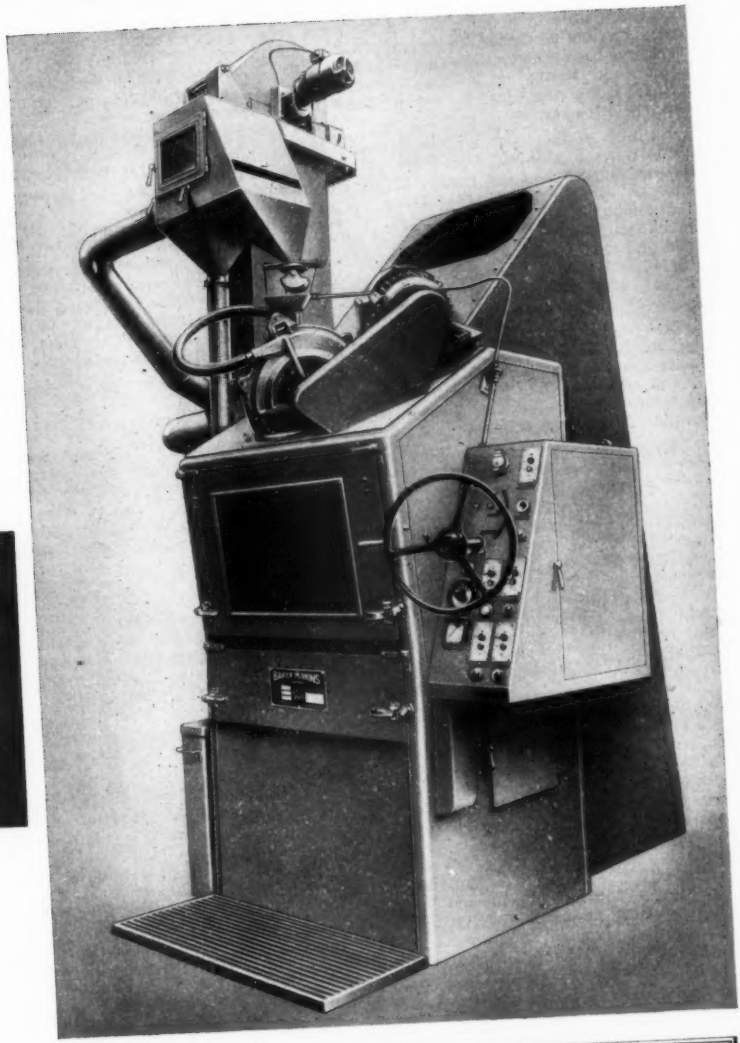
Mr. ROBERT SCOTT, at present vice-principal of Bolton Technical College, has been appointed principal of the Wolverhampton and Staffordshire Technical College in succession to Mr. C. L. OLD, who leaves in September to become group adviser on education to Vickers, Limited. Mr. Scott is a Cambridge graduate and has had industrial experience with the G. E. C. Company, Limited; Metropolitan-Vickers Electrical Company, Limited; and British Thomson Houston, Limited.

Mrs. M. K. CLELAND, personnel manager of Ranco, Limited, Newhouse, Motherwell, for the past four years, has left the firm. Mr. Norman Best, general manager and a director of the firm, presented her with a cigarette box on behalf of the management, while Mr. James Preston, secretary of the works advisory committee, handed her a voucher to buy a bookcase, a gift from the works personnel. Mr. Harry Lees, a long-serving employee, presented Mrs. Cleland with a gold watch from the staff.

BAKER PERKINS Shot Blast Equipment

Rotating Barrel Shot-Blast Machine





BAKER PERKINS LTD
Engineers
WESTWOOD WORKS - PETERBOROUGH

Raw Material Markets

Iron and Steel

The engineering foundries producing high-duty castings for many trades are favourably employed and those connected with the motor-car industry continue to obtain improved outputs of castings. This necessitates increased tonnages of pig-iron in the low-phosphorus and hematite grades. Up to the present the foundries have been able to acquire all the tonnages they have called for, but as demands increase tht low-phosphorus irons are becoming more stringent. Hematite pig-iron is in good supply, and those foundries in need of refined irons are able to obtain their requirements without difficulty.

Business at the light and textile foundries continues along moderate lines. The jobbing foundries have a fair amount of work on hand. Deliveries of the high-phosphorus iron which these foundries use are more than adequate to meet requirements. Export merchants have been offered limited quantities of hematite pig-iron and it is expected that no difficulty will be experienced in disposing of this. High-phosphorus pig-iron is also being exported, together with refined irons, and the low-phosphorus irons when licences can be obtained.

The foundries are well provided with scrap and are now more choosey in the parcels which arise. The heavier and better grades of cast-iron scrap are the most sought after, with the light and medium grades in little demand. Prompt delivery can be made of ganister, limestone, and firebricks.

The re-rollers are well provided with steel semis to enable them to undertake the work on hand, and fairly good outputs of their products are obtained. The stocks of steel which were built up recently by some units from increased imports are being depleted, and home steelworks are generally able to make good any deficiencies in supplies. Imports of steel semis are now restricted. Home consumers and stockists continue to specify regular requirements of light sections and small bars. Reinforcing rods continue in heavy demand, and improved tonnages of sheets and strip are being called for.

Non-ferrous Metals

Copper is a reasonably steady market, favourable influences more than offsetting the present bearish factors. Last week, after rising several points on the rumour which, unfortunately, many believed to be true, that Chilean production would be cut back 10 per cent., the market price fell sharply in the absence of any confirmation. The belief now is that it is unlikely that output from US copper producers in Chile will be lowered. Credence is given to this feeling by the report from Santiago that the 1957 production totalling an estimated 440,000 tonnes has been entirely sold. Further spokesmen for the US producers concerned have declared that they have no indication about cut-backs in production.

The sharp fall in the quotation in both London and New York had its repercussions in Canada, where several well-known copper-zinc producers have either passed or lowered their dividends. Against a wider background the Union of Mine, Mill and Smelter Workers has made a proposal to the Government to adopt a flow price on copper and for Government stockpiling measures. On this point it is felt that while the Canadian Government is unlikely to resort to stockpiling some kind of assistance similar to that granted under the present gold mining Assistance Act may be considered. Notwithstanding the obvious implications of the foregoing, copper has strengthened on the news that the Northern Rhodesian European mineworkers are seeking higher wages. This can be related to the fall in the copper bonus payable and it will be interesting to see whether the final settlement of this matter will involve the workers having to choose between higher wages and the copper bonus arrangement. Meanwhile, copper in London is active at the lower price level ruling, although New York is quiet, reflecting the vacation period.

Tin has lost its former firm look and has been drifting downwards in spite of the unsettled labour situation in Singapore Harbour. One bearish influence is the further rise of stocks in LME warehouses; another is that the buffer state manager is apparently out of the market and finally the holiday period in the US with its inevitable drop in consumer interest.

Lead is a featureless market on both sides of the Atlantic. In the US the chief development is the settlement of the seven-week strike at the American Smelting & Refining Company, Monterey, Mexico, refining plant. The US price is still 14 cents a pound.

Zinc is also dull and the London price is coming under pressure due to the settlement of the Belgian metalworkers' strike and further cut-backs in US production. The selling price of zinc in the US is 10 cents a pound.

Prospects for Engineering Apprentices

The Wellman Smith Owen Engineering Corporation, Limited, are starting an Indentured Apprenticeship Scheme at their Falls Foundry, Belfast, as an extension to a similar scheme which they have operated with signal success for over 30 years in their other works. Written applications are invited accordingly from, or on behalf, of boys between 15 and 16 years of age who desire to become trained, qualified craftsmen.

In addition to the craft apprentices, two student apprentices of at least 16 years old, who are intending to continue their studies to Higher National Certificate level, and who must attain this standard during the course of their apprenticeship, will also be accepted. The scheme will start as from September 2, and applications should reach the personnel officer at Falls Foundry, North Howard Street, Belfast, by Friday, July 26.

Nuclear Site Approved

The Minister of Power, Lord Mills, has given his consent to the construction of the £60,000,000 to £70,000,000 nuclear-power station at Hinkley Point, Bridgwater Bay, Somerset.

The tender for the construction of the station by the English Electric-Babcock and Wilcox-Taylor Woodrow group was submitted recently to the Central Electricity Authority. Examination and acceptance of this tender will be completed in August, and work on the site should commence, providing the tender is successful, in September.

Stewarts and Lloyds' Tollcross Steel Foundry

In the JOURNAL of June 13, when describing Stewarts and Lloyds' Tollcross foundry, the arc-furnace electrode control system was referred to as being of Italian design, whereas in actual fact it is the "Electrolic Arc Controller"—a hydraulic system developed by the makers of the furnace, Metalectric Furnaces, Limited. Apologies for this error are made to readers and the firms concerned.

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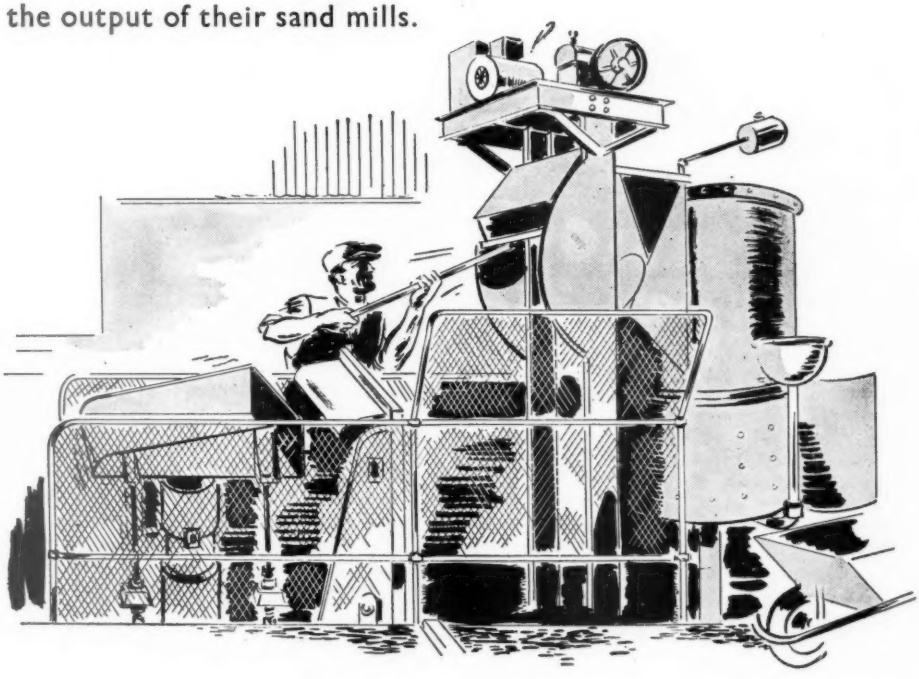
TRADE MARK

for quick bond development

'FULBOND' develops its bond so rapidly that foundrymen can reduce milling time and increase the output of their sand mills.



For service and information write to:

THE FULLERS' EARTH UNION LTD.

Patteson Court, Nutfield Road, Redhill, Surrey

Telephone: REDHILL 3521

CMF 13

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

July 17, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £20 1s. 0d.; Birmingham, £19 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £21 18s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £22 2s. 3d.

Scotch Iron.—No. 3 foundry, £23 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £24 6s. 6d.; South Zone, £24 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 14s. 0d.; South Zone, £25 16s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £22 17s. 6d.; Scotland (Scotch iron), Zone S. 1, £23 4s. 0d.; Sheffield, £24 4s. 6d.; Birmingham, £24 12s. 0d.; Wales (Welsh iron), £22 17s. 6d.

Basic Pig-iron.—£19 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 8d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 8d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3⅔d. per lb. Cr; 0.06 per cent. C,* 2s. 3½d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 22s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £82 12s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £30 9s. 0d.; tested, 0.08 to 0.25 per cent. C, £31 9s. 0d.; hard (0.41 to 0.60 per cent. C), £32 10s. 6d.; silico-manganese, £41 0s. 0d.; free-cutting, £34 13s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £38 4s. 6d.; silico-manganese, £41 7s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £36 3s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £37 6s. 0d.; acid, up to 0.25 per cent. C, £40 7s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £39 2s. 0d.; boiler plates (N.-E. Coast), £41 12s. 0d.; floor plates (N.-E. Coast), £40 11s. 0d.; sectional material, N.-E. Coast, £37 11s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £37 18s. 0d.; flats, 5 in. wide and under (4-ton lots), £37 18s. 0d.; hoop and strip, £37 17s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £41 6s. 0d.; black sheets (hand mill), 17/20 g., £52 4s. 6d.; galvanized corrugated sheets, 24 g., £64 1s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £65 10s. 3d., nickel-chrome, £92 13s. 0d.; nickel-chrome-molybdenum, £104 11s. 6d.

NON-FERROUS METALS

Copper.—Cash, £215 5s. 0d. to £215 10s. 0d.; three months, £217 15s. 0d. to £218 0s. 0d.; settlement, £215 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 1d. per lb.; rods, 245s. 0d. per cwt. basis; 20 s.w.g., 278s. 3d. per cwt.

Tin.—Cash, £747 0s. 0d. to £748 0s. 0d.; three months, £744 10s. 0d. to £745 0s. 0d.; settlement, £748 0s. 0d.

Lead (Refined Pig).—Second half July, £89 0s. 0d. to £89 5s. 0d.; second half October, £90 5s. 0d. to £90 10s. 0d.

Zinc.—Second half July, £73 15s. 0d. to £74 0s. 0d.; second half October, £72 10s. 0d. to £72 15s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £109 15s. 0d.; rolled zinc (boiler plates), all English destinations, £107 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 8¾d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 183s. 9d. per cwt.; wire, 2s. 5¾d.; rolled metal, 183s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £150; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £205; HTB2 (38 tons), — ; HTB3 (48 tons), — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £192; LG3 (86/7/5/2), £203; G1 (88/10/2/½), £266; (88/10/2/1), £248.

Phosphor Bronze.—BS1400, PB1 (AID released), £285 per ton.

Phosphor Bronze Strip, etc.—Strip, 267s. 9d. per cwt.; sheets to 10 w.g., 287s. 0d. per cwt.; wire, 3s. 9¾d. per lb.; rods, 3s. 1¾d.; tubes, 3s. 1¾d.; chill cast bars: solids 3s. 1¾d., cored 3s. 2¼d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 8d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 0¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 11¾d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £90 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £248; AB2, — .

* Average 68-70 per cent.